The Interface of the Structural Equation Model and the Arbitrage Pricing Theory

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Abstract

The Arbitrage Pricing Theory (APT) is very popular in modeling securities return in the financial market. However there are many criticisms concerning the estimation of the pricing equation that is the central conclusion of the APT. The main criticism focuses on the validity of the conclusion that is produced by estimating the factor model and the pricing equation separately. This two-stage Classical approach is seriously criticized for its error-in-variable problem. In view of this, a new approach that is based on the Structural Equation Model (SEM) is developed to estimate the factor model and the pricing equation in a single step.

The SEM approach estimates parameters simultaneously and will not lead to the error-in-variable problem. hence providing more statistical sound estimates. Furthermore, the validity for both the factor model and the estimated pricing equation can be assessed concurrently, therefore leading to a valid judgment for the proposed APT model. Since the SEM is a confirmatory approach. it allows the incorporation of expertise in the estimation process that makes the estimated model more realistic and comprehensible. In addition. this advanced approach facilitates the modeling and analysis of both observed economic factors and unobservable factors. An empirical study based on stocks from the Hong Kong Hang Seng Index (HSI) and simulation studies are used to demonstrate the application of both the Classical and the SEM approach.

摘　要

在金融市場，套戥理論被廣泛應用於建造衍生利潤的模型。但對於其理論的核心結論即定價方程式的估計，卻遇到相當的批評。當中主要的批評是關於在分別估計因子模型與定價方程式之下，所作出結論的合法性。而這傳統的兩階段分析方法所引致的變量誤差問題，更被嚴厲地批評。有鑑於此，我們根據結構方程模型，引入一項新方法讓因子模型與價格方程式可於一步內同時被估計。

在結構方程模型的方法下，參數可同時被估計，所以不會引致變量誤差的問題；因此參數估計將更加可靠。除此之外，因子模型與價格方程式的合理性將可同時給予評估，讓對於假定的套戥理論所引申出的模型得以合理的判斷。基於結構方程模型是一項確認性的方法，所以專業的意見可一併放於估計的過程當中，而估計的模型將會更與現實相符及更易於理解。除此之外，這嶄新的方法更能讓建模及分析可見經濟因素及不可見的潛在因素變得更為容易。而我們將會透過對於香港恒生指數成份股的實證研究及模擬研究，示範傳統方法及結構方程模型方法的實際應用。

Declaration

No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institution of learning.

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Chapter 1

Introduction

The Arbitrage Pricing Theory (**APT**) is originated by Ross (1976) and extended by Huberman (1982). Market model implied from the theory has been widely adopted in financial modeling after its introduction. Its popularity mainly comes from the less stringent requirement, more plausible assumptions and also its better ability in explaining anomalies. The mechanism of the theory will be introduced in Chapter 2.

Common estimation practice in building a model based on the APT is a two-pass process, which is called the Classical approach. It is composed by a factor model and a cross-sectional regression model. However, empirical studies concerning the theory that employ this two-pass method suffer from great criticism in many aspects. In Chapter 3, the framework and the incurred critiques will be addressed in details.

The crucial criticisms arised from the separation of estimation process into two stages. Therefore, in Chapter 4 a prominent technique, the SEM approach, will be introduced in which the estimation process can be accomplished within one step. Its framework and advantages over the existing method would be stated in the mean time. A deeper comparison, which is based on a simulation study, would also be discussed in Chapter 5. Moreover, application of the SEM approach based on real data will be illustrated in Chapter 6.

Finally, the overall advantages of the SEM approach over the Classical one will be summarized in Chapter 7. Direction for possible future research will be suggested as well.

Chapter 2

The Arbitrage Pricing Theory

2.1 Model and Assumptions

The Arbitrage Pricing Theory (**APT**) is an asset pricing model, that is proposed by Ross (1976). The theory is derived based on the view that securities are close substitutes. Consequently, slight deviation in pricing leads to a chance in making profit. The deviation in demand then will drive up the price of the securities up and thereby a drop in profit. These trading activities will continue until all arbitrage possibilities are eliminated. In other words, the market is in equilibrium when no arbitrage possibility is present.

The primitive assumption of the APT, is that the covariation among assets' returns can be linearly captured by K systematic factors. When every investor has homogeneous belief concerning the movement of return, the relationship among the random return of a security r_i, the K *common* (or *systematic*) factors f_1, $\ldots$, f_K and a *unique* (or *unsystematic*) factor ε_i can be depicted as below.

$$r_i = b_{i0} + b_{i1} f_1 + \ldots + b_{iK} f_K + \varepsilon_i \qquad \text{for } i = 1, \ldots, n. \tag{2.1}$$

By taking expectation on both sides, we have

$$E(r_i) = b_{i0} + b_{i1} E(f_1) + \ldots + b_{iK} E(f_K) + E(\varepsilon_i). \tag{2.2}$$

Denote the expected return of security-i, $E(r_i)$, by μ_i. Then b_{i0} can be expressed as

$$b_{i0} = \mu_i - b_{i1}E(f_1) - \ldots - b_{iK}E(f_K) \tag{2.3}$$

since $E(\varepsilon_i) = 0$.

Substitute (2.3) into (2.1), it becomes

$$r_i = \mu_i + b_{i1}(f_1 - E(f_1)) + \ldots + b_{iK}(f_K - E(f_K)) + \varepsilon_i. \tag{2.4}$$

If $f_1, f_2, \ldots, f_K$ are considered to be mean zero, (2.4) can be simplified as

$$r_i = \mu_i + b_{i1}f_1 + \ldots + b_{iK}f_K + \varepsilon_i. \tag{2.5}$$

Referring to (2.5), the common factors capture the systematic component of risk with b_{ij} quantifying the sensitivity of security-i to the j^{th} common factor. In contrast, the unique factor ε_i is a risk component that is idiosyncratic to its corresponding security. To enable the separation of common risk and unique risk, a further assumption, $cov(\varepsilon_i,\ f_j) = 0$ for all i and j, is needed.

Suppose now an investor is holding a portfolio consisting of n securities with a_i fraction of funds invested in the security-i. The expected return of the portfolio $\overline{r}_{(p)}$ equals the weighted average of the expected return on the individual securities. That is,

$$\overline{r}_{(p)} = E(r_{(p)}) = \sum_{i=1}^{n} a_i\overline{r}_i.$$

Meanwhile, the factor sensitivity of the portfolio corresponding to each of the K factors can be expressed as

$$b_{(p),j} = \sum_{i=1}^{n} a_i b_{ij} \qquad \text{for } j = 1, \ldots, K.$$

Denote $var(\varepsilon_i)$ and the average variance of ε_i by $\sigma_i{}^2$ and $\overline{\sigma}^2 = \frac{1}{n}\sum_{i=1}^{n}\sigma_i{}^2$ respectively. If equal funds are invested in each of the securities with the mutually independent assumption of the unique factors, then the unique risk of the portfolio is

$$var(\sum_{i=1}^{n} a_i\varepsilon_i) = \frac{1}{n}\,\overline{\sigma}^2$$

which tends to zero when n is sufficiently large. Hence, for a well-diversified portfolio, the unique risk is not of concerned and what will matter is the systematic risk. Ultimately, variation of the portfolio return can be expressed as

$$\sigma^2{}_{(p)} = (a^T B)\Phi(a^T B)^T$$

where $a = (a_1, \ldots, a_n)^T$ is a vector containing the proportion of investment in each of the n portfolio constituents; $\Phi = cov(f_1, \ldots, f_K)^T$ denotes the covariance matrix among the factors which are the main driving force in the return-generating process and $B = (b_1, \ldots, b_K)$ is the factor loading matrix, with $b_j = (b_{1j}, \ldots, b_{nj})^T$ containing the sensitivities of the n securities to the j^{th} factor. Nevertheless, terms that affect the systematic risk in a portfolio are $b_{(p),1}, \ldots, b_{(p),K}$. Since investors only concern with the expected return and risk that they would envisage, only $K+1$ attributes of a portfolio are of concerned, and they are the portfolio return $\bar{r}_{(p)}$ and the portfolio risk $b_{(p),1}, \ldots, b_{(p),K}$.

2.2 Derivation of the APT

Suppose now an investor considers to change the composition of his or her existing portfolio. Let $x = (x_1, \ldots, x_n)^T$ be the change in the portfolio proportion for each of the components. If the investor puts in no extra capital, this alternation vector x must satisfy $\sum_{i=1}^{n} x_i = 0$. Generally, it is equivalent to express this condition as

$$x^T c = 0 \tag{2.6}$$

where c is a $n \times 1$ column vector, with all of its elements equal to an arbitrary constant, say λ_0.

Under the theoretical assumption of a frictionless market, every investor should have the same chance to search for a possible increase in his or her portfolio return. If this gain induces no extra risk and requires no additional investment, then this portfolio is said to be an *arbitrage portfolio*.

From (2.5), the change in portfolio return for the re-structured portfolio equals

$$
\begin{aligned}
x^T r &= \sum_{i=1}^{n} x_i r_i \\
&= \sum_{i=1}^{n} x_i(\mu_i + b_{i1} f_1 + b_{i2} f_2 + \ldots + b_{iK} f_K + \varepsilon_i) \\
&= \sum_{i=1}^{n} x_i \mu_i + \sum_{i=1}^{n} x_i b_{i1} f_1 + \sum_{i=1}^{n} x_i b_{i2} f_2 + \ldots + \sum_{i=1}^{n} x_i b_{iK} f_K + \sum_{i=1}^{n} x_i \varepsilon_i \\
&= x^T \mu + x^T b_1 f_1 + x^T b_2 f_2 + \ldots + x^T b_K f_K + x^T \varepsilon \qquad (2.7)
\end{aligned}
$$

where $r = (r_1, \ldots, r_n)^T$ and $\mu = (\mu_1, \ldots, \mu_n)^T$ contain the random return and the expected return for each of the n portfolio components respectively. While, $\varepsilon = (\varepsilon_1, \ldots, \varepsilon_n)^T$ contains the corresponding unique factors.

If the economy consists of an infinite number of assets or it is so large that the law of large number can be applied, then the last term $x^T\varepsilon$ in (2.7) can be approximated to be zero. Hence (2.7) becomes

$$x^T r = x^T \mu + x^T b_1 f_1 + x^T b_2 f_2 + \ldots + x^T b_K f_K. \qquad (2.8)$$

To be an arbitrage portfolio, it should bear no additional risk for an extra gain. As the unique risk can be diversified away, the only risk that subject to consideration is the systematic risk. Therefore, the change in the systematic risk for an arbitrage portfolio should equal to zero as well. That is,

$$x^T b_j = 0 \qquad \text{for } j = 1, \ldots, K. \qquad (2.9)$$

Substitute this constraint to (2.8), the additional return arised from restructuring the original portfolio becomes

$$x^T r = x^T \mu.$$

However when the market is in equilibrium, no arbitrage opportunity should be present. In other words, a portfolio satisfying (2.6) and (2.9) should not give rise to any additional gain. Hence, the return of an arbitrage portfolio finally would become

$$x^T r = x^T \mu = 0. \qquad (2.10)$$

In brief, without using extra capital, $x^T c = 0$, and bearing no additional risk, $x^T b_j = 0$ for $j = 1, \ldots, K$, the portfolio should not provide additional gain in an equilibrium market, $x^T \mu = 0$. Mathematically, it is equivalent to claim that μ has a linear relationship with $c = \lambda_0 1$ and $B = (b_1, \ldots, b_K)$ as follow:

$$\begin{aligned} \mu &= \lambda_0 1 + \lambda_1 b_1 + \lambda_2 b_2 + \ldots + \lambda_K b_K \\ &= \lambda_0 1 + B\lambda \end{aligned} \tag{2.11}$$

where $\lambda = (\lambda_1, \ldots, \lambda_K)^T$ are the corresponding coefficients of B.

Equation (2.11) is named as the *pricing equation*, which is the central conclusion of the APT. It concludes that the excess expected returns (μ -$\lambda_0 1$) lie in the space spanned by the factor loadings $b_1, \ldots, b_K$. The constant term λ_0 in (2.11) is the return when the portfolio does not subject to any systematic risk, which is interpreted as the risk-free rate r_f. On the other hand, $\lambda_1, \ldots, \lambda_K$ are named as the *factor risk premium.*

2.2.1 Factor Risk Premia

Consider $\mu^{(j)}$ to be the return of a portfolio with only unit systematic risk on the j^{th} factor; that is $b_i = 1$ when $i = j$ and 0 otherwise. It results in $\mu^{(j)} = \lambda_0 + \lambda_j$. With appropriate rearrangement, the risk premia of the j^{th} factor can be expressed as

$$\lambda_j = \mu^{(j)} - r_f. \tag{2.12}$$

Therefore, the pricing equation in (2.11) can be written in another form

$$\mu = r_f 1 + (\mu^{(1)} - r_f)b_1 + (\mu^{(2)} - r_f)b_2 + \ldots + (\mu^{(K)} - r_f)b_K. \tag{2.13}$$

The factor f_j will be claimed to be priced if its corresponding factor risk premia λ_j in (2.12) is non-zero, which is equivalent to have $\mu^{(j)} \neq r_f$. While the value of r_f represents the return of a riskless security, therefore a non-zero value of λ_j is referring to the extra return provided for the risk that is induced by f_j.

Chapter 3

The Classical Approach

Existing technique in estimating the pricing equation is a two-pass method, which is termed as the Classical approach. When the underlying factors are some observed economic indicators, a regression model will be fitted in the first stage. However, factors are usually unobserved in most circumstances. A statistical factor model would often be adopted to uncover and identify the latent factors. Then, a Cross-sectional Regression (**CSR**) would be performed, with the estimated regression coefficients or the factor loadings $\widehat{b}_1, \ldots, \widehat{b}_K$ from the previous stage as the explanatory variables. Afterall, validity of the model and the significance of the presumed factor risk premium $\lambda_1, \ldots, \lambda_K$ can be judged from the CSR result.

3.1 Factor Analysis

When the underlying factors are unobservable, the exploratory statistical technique, Principle Factor Analysis (**PFA**), is usually employed in the first stage to analyze the factor model. Factor loading matrix $B = (b_1, \ldots, b_K)$ is estimated such that it can best capture the sample covariances existing among the securities. Other techniques such as the Principle Component Analysis (**PCA**) can be employed. The main difference between PFA and PCA is that PCA aims at capturing variances of the observed variables while PFA aims at capturing the covariances instead. Connor (1995) has tested the explanatory power of different factor models based on the number of factors they have included. Two alternative factor models, the macroeconomic factor model and the fundamental factor model, are compared. Concretely, macroeconomic factor models are constructed by treating some observable economic fundamentals as the systematic factors based on an intuitive sense. Therefore, it reduces to a time-series regression model. On the other hand, fundamental factor models are constructed with some empirically determined attributes acting as the factor loadings in the return-generating process. Nevertheless, the statistical factor model has found to be outperform the other two models in terms of the explanatory power.

For a n assets portfolio, the return-generating process that follows a K factor model can be depicted as

$$\begin{aligned} r_i &= b_{i0} + b_{i1}f_1 + b_{i2}f_2 + \ldots + b_{iK}f_K + \varepsilon_i \qquad \text{for } i = 1, \ldots, n \\ \text{or} \qquad r &= b_0 + b_1 f_1 + b_2 f_2 + \ldots + b_K f_K + \varepsilon \end{aligned} \tag{3.1}$$

where ε is a $n \times 1$ vector of measurement errors. It is assumed that $\mathrm{E}(\varepsilon) = 0$ and $\Theta_\varepsilon = \mathrm{E}(\varepsilon\varepsilon^T)$ is a $n \times n$ diagonal matrix comprising the unique risk components.

The Maximum Likelihood (**ML**) optimization procedure, suggested by Jöreskog (1967), would be adopted to estimate the loading matrix B and the error covariance matrix Θ_ε in an iterative manner. The resultant estimates are most consistent with the sample data under the assumed normal distribution concerning the securities' return $r = (r_1, \ldots, r_n)^T$ and factors $f = (f_1, \ldots, f_K)^T$. Meanwhile, it enables us to perform a Likelihood Ratio (**LR**) test to estimate K, which is usually unknown.

The null hypothesis of a LR test concerns the sufficiency of K factors in explaining the return-generating process. The corresponding likelihood ratio is obtained by dividing the likelihood value for a specific K by the unconstrained likelihood value. Under the null hypothesis, twice the natural logarithm of the likelihood ratio is asymptotically χ^2 distributed with degrees of freedom equal to $\frac{1}{2}[(n-K)^2 - (n+K)]$. The test would proceed on with K being raised by one each time, until the null hypothesis is not rejected. Therefore, K can be estimated.

Other tests may also be employed in determining the number of factors. For example, values of the eigenvalues for the correlation matrix are checked under the Kaiser-Guttman rule (1954, 1960). On the other hand, an appreciable drop of eigenvalues is examined under the Scree test by Cattell (1966). However these two methods are not recommended in general because they are either not robust or being too subjective. Loehlin (1992) pointed out that chance fluctuations might easily make an eigenvalue moving around the fixed borderline, which may lead to a different decision for the number of factors. For the Scree test, there is difficulty in detecting a substantial drop in eigenvalues when the model consists a small number of variables.

Apart from the ML algorithm, the Generalized Least-Squares (**GLS**) optimization procedure may also be employed if K is known or predetermined. However the ML procedure is preferred in a statistical sense. Specifically, it is possible to calculate estimated standard error for each factor loading estimate and hence to conduct the traditional statistical test about the significance of the loadings.

Moreover, the fit function under the ML algorithm F_{ML} can be used to define a variety of goodness-of-fit indices for evaluating the overall model fit. The value of fit function is minimized sequentially to give better estimates. The fit function subjects to minimization is

$$F_{ML} = log|S| - log|\Sigma| + Tr(S\hat{\Sigma}^{-1}) - n \tag{3.2}$$

where S is the observed sample covariance matrix, $\hat{\Sigma}$ is the predicted covariance matrix and n is the order of the sample covariance matrix. Without loss of generality, the underlying factors are assumed to be mean zero and being orthonormal so as to eliminate the problem of indeterminacy. That is,

$$E(f) = 0 \qquad \text{and} \qquad cov(f) = I.$$

Understanding that factor analysis is indeed a technique based on analyzing the covariance structure in the sample. The estimation process therefore reduces to find the estimates of B and Θ_ε such that the sample covariance matrix $S = \widehat{\Sigma}$ can be best modeled by the following relationship in the population.

$$\Sigma = BB^T + \Theta_\varepsilon \tag{3.3}$$

After estimating the factor model, significance for each factor coefficient b_{ij} can be judged according to the t-statistic obtained from the above Exploratory Factor Analysis (**EFA**).

3.2 The Cross-sectional Regression

Once the estimates of the factor loading matrix B are obtained, the next step is to estimate the factor risk premium $\lambda_1, \ldots, \lambda_K$ in the pricing equation. A cross-sectional regression over the time period T would be performed. Either the GLS or ML optimization algorithm would be adopted, since they are equivalent under the normal assumption.

One crucial point is the time-invariant assumption regarding the estimation process throughout the sample period, T. Thereby, the mean return μ_i will be regressed on the presumed time-invariant factor loadings $b_{i1}, \ldots, b_{iK}$ across the concerned time interval. Thus, the factor risk premium in the pricing equation can be estimated from

$$\begin{aligned} \mu_i &= \lambda_0 + \lambda_1 b_{i1} + \ldots + \lambda_K b_{iK} \\ &= r_f + \lambda_1 b_{i1} + \ldots + \lambda_K b_{iK} \qquad \text{for all } i. \end{aligned} \tag{3.4}$$

In practice, $\widehat{b}_{i1}, \ldots, \widehat{b}_{iK}$ obtained from (3.1) would be substituted to be the observed explanatory variables in (3.4), based on the assumption of the absence of measurement error concerning b_{ij}. While the sample mean return $\overline{r}_i$ would be regarded as the dependent variable. Then the pricing equation in (3.4) becomes

$$\overline{r}_i = \frac{1}{T}\sum_{t=1}^{T} r_{i,t} = r_f + \lambda_1 \widehat{b}_{i1} + \ldots + \lambda_K \widehat{b}_{iK} + e_i \tag{3.5}$$

where e_i is a random residual error term assumed being uncorrelated to each other and of mean zero. That is,

$$E(e_i) = 0 \text{ for all } i \qquad \text{and} \qquad cov(e_i, e_j) = 0 \text{ for } i \neq j.$$

Thereafter, significance of the presumed pricing factors can be tested according to the estimates in (3.5) by assuming the factor model in (3.1) has been correctly specified. The theory will not be rejected if the joint hypothesis H_0: $\lambda_1 = \ldots = \lambda_K = 0$ is rejected. Besides, validity of the estimated pricing equation in (3.5) can be determined based on the coefficient of determination, R^2.

Finally, the priced factors should be identified. It is achieved through rotating the orthonormal factors in (3.1), whereas interpretation is sought through inspecting the pattern of the rotated loading matrix.

3.3 Critiques Concerning the APT

In spite of the nice properties of the theory, the estimation method that encumbers empirical studies towards the APT suffers from heavy criticism. Most of the debates concern the use of $\widehat{b}_{i1}, \ldots, \widehat{b}_{iK}$ as the explanatory variables in (3.5); however they are estimates indeed and suffer from sampling error. The use of such explanatory variables thus causes the so-called Error-in-variable (**EIV**) problem.

One of the strict assumptions being imposed in the first-stage estimation is the independence structure among the residuals. Returns among securities are only allowed to be correlated through factors, while residuals are uncorrelated. Ordinary tests concerning the validity of the APT is based on this fundamental assumption. However, firms belonging to the same industry might possess an industry-specific effect on their returns. Residual variance would be underestimated if this is the case. Wong (1994) has tried to free the elements of error covariance in fitting a Capital Asset Pricing Model to 13 Hang Seng Index constituents. A Lagrangian Multiplier test with LISREL approach was performed to identify which error covariance terms are needed to be set free. The result indicates that setting some of the error covariance terms free for estimation is necessary. These error covariance terms are in fact significant that help to give a better goodness-of-fit. Jones (2001) has proposed a framework to deal with the heterogeneity problem in factor analysis; however it is still unable to model error covariances. In order to perform individual test for "pricing" factors in the CSR model, the error terms must be uncorrelated. While test for "pricing" factors is a critical step in constructing the APT model, modeling of error covariances would be sacrificed so as to enable the tests in the Classical approach.

Another problem is that there is no way to incorporate expertise or any well-known market information in the estimation process. As stated before, it is logical for firms under the same industry to have correlated residuals. However, no common practice is available. Therefore, the estimated model can only have a statistical sense but lack of an interpretative meaning corresponding to the realistic capital market.

Since the Classical approach involves two separate estimation steps, there is no index that can indicate the direction to revise the model with both the factor model and the CSR model being taken into account.

Another issue that of concerned is the testability of the APT. Ordinary test against the APT is accomplished through examining the non-existence of extra factors hindering in the residuals for the CSR model. Since the elimination of residuals is believed to be practicable by forming a diversified portfolio, which implies that expected return should not be affected by residuals. The APT would be rejected once the residuals are found to have the ability in explaining the movement of returns. However, the test of APT only involves testing the pricing equation while the factor model is assumed to be known or can be correctly specified. In fact, the overall APT cannot be justified under the two-pass approach.

Empirical study by Chen (1983) shows that tests against the APT based on the Classical approach will be biased, if any important factor is missed owing to the use of unrepresentative sample. Besides, Roll and Ross (1980) have pointed out that the test for "pricing" factors based on (3.4) is biased.

Even the APT can be shown to be valid, there is still difficulty in identifying the underlying factors. Rotation is usually adopted to seek interpretative meaning for the factors in terms of some economic fundamentals. Indeed, it is a quantitative procedure that aims to transform a loading matrix to one with simpler structure. But, it does not provide the practicability to express a rotated factor in terms of some observed economic fundamentals. On the other hand, Shanken (1982) demonstrates that factor structures originated from factor analysis can be very different when unrepresentative assets are utilized. Furthermore, there is no assurance that factors being identified for a portfolio would conform among different sample period.

The above listed crucial defects arised from the Classical method seriously set back the development concerning the APT.

Chapter 4

The Structural Equation Model Approach

In view of the problems being addressed in the previous chapter, the use of Structural Equation Model (**SEM**) is proposed to substitute the Classical one. The estimation procedure concerning the factor model and the pricing equation is consolidated into a one-stage process. This one-stage process is achieved through analyzing the factor model in (2.1) and the pricing equation in (2.11) simultaneously.

4.1 Combining the Factor Model and the Pricing Equation

Consider the K underlying factors $F_1, F_2, \ldots, F_K$ having non-zero mean, the return-generating process can be depicted as follows:

$$r_i = b_{i0} + b_{i1}F_1 + b_{i2}F_2 + \ldots + b_{iK}F_K + \varepsilon_i \qquad \text{for } i = 1, \ldots, n. \tag{4.1}$$

Taking expectation on both sides of (4.1), the expected return of security-i becomes

$$\mu_i = E(r_i) = b_{i0} + b_{i1}E(F_1) + b_{i2}E(F_2) + \ldots + b_{iK}E(F_K). \tag{4.2}$$

By substituting it into (4.1), the standard form of the factor model can be obtained and is given by

$$\begin{aligned} r_i &= E(r_i) + b_{i1}(F_1 - E(F_1)) + b_{i2}(F_2 - E(F_2)) + \ldots + b_{iK}(F_K - E(F_K)) + \varepsilon_i \\ &= \mu_i + b_{i1}f_1 + b_{i2}f_2 + \ldots + b_{iK}f_K + \varepsilon_i \end{aligned} \tag{4.3}$$

where $f_j = F_j$ - $E(F_j)$. Note that equation (4.3) is reduced to the same form as (2.5). By further substituting (2.11) into (4.3) and replacing b_{i0} by r_f, we have

$$\begin{aligned} r_i &= [r_f + b_{i1}\lambda_1 + b_{i2}\lambda_2 + \ldots + b_{iK}\lambda_K] + b_{i1}f_1 + b_{i2}f_2 + \ldots + b_{iK}f_K + \varepsilon_i \\ &= r_f + b_{i1}(f_1 + \lambda_1) + b_{i2}(f_2 + \lambda_2) + \ldots + b_{iK}(f_K + \lambda_K) + \varepsilon_i \end{aligned} \tag{4.4}$$

which reduces to a combined model comprising the factor model and the pricing equation.

4.2 Framework of the SEM with Mean Structure

The estimation of pricing equation through the SEM methodology is derived based on the x measurement model in a LISREL model. Observed variables $x = (x_1, \ldots, x_n)^T$ are served as indicators for the unobserved factors $\xi = (\xi_1, \ldots, \xi_K)^T$ through regressing x on ξ.

Indeed, $\xi^* = ({\xi_1}^*, \ldots, {\xi_K}^*)^T$ is considered, in which $\xi^* = \xi + \kappa$. Intuitively, ξ^* has a non-zero mean $\kappa = (\kappa_1, \ldots, \kappa_K)^T$, which is termed as *latent mean*. It is the presence of this additional structure that leads the SEM analysis complicated. On the other hand, the intercept vector $\tau = (\tau_1, \ldots, \tau_n)^T$ is assumed to be non-zero when κ is free for estimation. Therefore, the general form of the x measurement model that is subsumed in the SEM can be written as follow:

$$\begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{pmatrix} = \begin{pmatrix} \tau_1 \\ \tau_2 \\ \vdots \\ \tau_n \end{pmatrix} + \begin{pmatrix} \omega_{11} & \omega_{12} & \ldots & \omega_{1K} \\ \omega_{21} & \omega_{22} & \ldots & \omega_{2K} \\ \vdots & \vdots & \ddots & \vdots \\ \omega_{n1} & \omega_{n2} & \ldots & \omega_{nK} \end{pmatrix} \begin{pmatrix} \xi_1 + \kappa_1 \\ \xi_2 + \kappa_2 \\ \vdots \\ \xi_K + \kappa_K \end{pmatrix} + \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_n \end{pmatrix}$$

$$\text{or} \qquad x = \tau + \Omega(\xi + \kappa) + \varepsilon$$

$$\text{or} \qquad x = \tau + \Omega\xi^* + \varepsilon \tag{4.5}$$

where Ω contains the regression coefficients ω_{ij} for $i = 1, \ldots, n$, $j = 1, \ldots, K$; while $\varepsilon = (\varepsilon_1, \ldots, \varepsilon_n)^T$ represents the measurement errors.

Specifically, the SEM would model the measurement errors ε as well. Allowance for the presence of ε implies that observed variables cannot be some infallible indicators for the unobserved factors. Beware that measurement errors ε are assumed to be uncorrelated with the systematic factors ξ^*, but they could be correlated among themselves. That is, both $cov(\varepsilon) = \Theta_\varepsilon$ and $cov(\xi^*) = \Phi$ can possess non-zero values in the off-diagonal entries.

Owing to the presence of unobserved factors in the model, parameters cannot be directly estimated. Instead, the covariance structure among the observed variables, denoted by S, would be analyzed. In order to satisfy the relationship among x and ξ^* in (4.5), the model implied covariance matrix Σ should satisfy the covariance equation: $\Sigma = \Omega\Phi\Omega^T + \Theta_\varepsilon$. Since the implied covariance matrix is a function for part of the parameters of interest, estimates of the loading matrix Ω, the factor covariance matrix $\Phi = \mathrm{E}[(\xi^* - \kappa)(\xi^* - \kappa)^T]$ and the error covariance matrix $\Theta_\varepsilon = \mathrm{E}(\varepsilon\varepsilon^T)$ can be obtained. On top of it, the mean structure of x, denoted by μ, would be analyzed concurrently. The unobserved mean vector κ and the intercept vector τ would be estimated which would satisfy the following relationship:

$$\mu = \tau + \Omega\kappa. \tag{4.6}$$

The goodness-of-fit of a model would be judged after each estimation process. Basically, a model's fit reflects the degree of consistency between a hypothetical model and the input data. Yet, if the sample is large enough, it is reasonable to use sample covariance and sample mean to estimate the population covariance and mean. Hence, the goodness-of-fit is referring to the closeness of a hypothetical model and the population model in some sense. For the SEM in (4.5), both the model implied covariance matrix $\widehat{\Sigma}$ and mean vector $\widehat{\mu}$ would be compared to S and $\overline{x}$ respectively. The closer they are, the better is the fit.

The software LISREL will be adopted in the forthcoming analysis, because of its advanced built-in function, especially for the SEM analysis. In particular, the analysis of latent mean structure for SEM using LISREL was first proposed by Sörborm (1974).

For the above estimation, six types of parameters are involved; they are the parameters in τ, Ω, κ, ε, Φ and Θ_ε. In practice, some of them will be fixed to a specific value, called fixed parameters; some will be unknown but constrained to be equal to other elements, named as constrained parameters; and some will be unknown and unconstrained, named as free parameters. Nevertheless, it is always necessary to fix or constrain some parameters to address the model identification problem.

The identification problem arises when the information provided is insufficient to give a unique solution for each of the parameters. When this problem occurs, the model is said to be unidentified. Information that can be provided for fitting the SEM are the covariance matrix and the mean vector of the observed variables x. For the model in (4.5), the number of non-redundant information to be input equals to $\frac{n(n+1)}{2} + n$. In order to guarantee a model is identified, this number should be equal to or greater than the number of parameters to be estimated. However, this condition is necessary but is not sufficient for identification. To demonstrate a SEM is identified, it is necessary to express each of the parameters in terms of the population variances, covariances and means of the observed variables. In practical applications, detecting the presence of identification problem can be tied to the built-in diagnostic facility in the software.

Since unobserved factors are involved in the SEM model, they possess neither a definite scale nor an origin, which is named as a metric wholly. Hence, a metric should be assigned for each of the factors in order to produce a well defined model.

Without explicit specification, a SEM is assumed to have zero unobserved mean in LISREL. For a SEM with $\kappa = 0$, an observed variable would be selected to act as a reference variable for each of the factors. Typically, a reference variable is the indicator that loads most heavily on the dimension represented by the corresponding factor. Therefore, both the meaning and scale for an unobserved factor can be anchored to that variable. For instance, fixing the value of ω_{ij} to one ensures that the unobserved factor ξ_j is measured on the same scale as the reference variable x_i. While under the assumption of zero unobserved mean, the origin for each of the factors is assigned implicitly at the same time when the scale is provided. Alternatively, one may set all diagonal elements in the factor covariance matrix to one. A scale is set up through producing a standardized solution for the underlying factors.

However, the setting of a metric is much rigorous when the unobserved mean is non-zero. Assume that x_i is selected to be the reference variable for ξ_j. Similarly, a scale is provided through fixing the value of ω_{ij}. But in order to assign an origin for ξ_j when $\kappa \neq 0$, both the intercept term τ_i and the full row of loadings $(\omega_{i1}, \ldots, \omega_{iK})$ corresponding to the reference variable are required to be fixed in the meantime. Therefore, K rows in the loading matrix and the intercept vector are required to be fixed for a K factors model. Failure to assign a metric for any one of them will lead to a model which is not identified and cannot be estimated.

4.3 Applying the SEM Approach to the APT

With the availability of mean structure analysis provided in the SEM framework, estimation for the combined factor model and the pricing equation in (4.4) can be accomplished within one step. Treating the mean of the unobserved factors as the risk premium, $\kappa = \lambda$, and the intercept vector as the constant risk-free rate, $\tau_i = r_f$ for all i; then the combined model in (4.4) can be written in a SEM framework like (4.5) as follow:

$$\begin{pmatrix} r_1 \\ r_2 \\ \vdots \\ r_n \end{pmatrix} = \begin{pmatrix} r_f \\ r_f \\ \vdots \\ r_f \end{pmatrix} + \begin{pmatrix} b_{11} & b_{12} & \ldots & b_{1K} \\ b_{21} & b_{22} & \ldots & b_{2K} \\ \vdots & \vdots & \ddots & \vdots \\ b_{n1} & b_{n2} & \ldots & b_{nK} \end{pmatrix} \begin{pmatrix} f_1 + \lambda_1 \\ f_2 + \lambda_2 \\ \vdots \\ f_K + \lambda_K \end{pmatrix} + \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_n \end{pmatrix}$$

$$\text{or} \qquad r = r_f 1 + B(f + \lambda) + \varepsilon$$

$$\text{or} \qquad r = r_f 1 + Bf^* + \varepsilon. \tag{4.7}$$

To further simplify the notation, $f^* = f + \lambda$ is considered, where f^* has a mean vector λ and the same covariance matrix as $f = (f_1, \ldots, f_K)^T$.

As mentioned previously, the intercept terms corresponding to the reference variables are required to be fixed in order to assign an origin for the unobserved factors. Hopefully, the return rate of a riskless security is often available. Therefore, the whole intercept column vector could be fixed for analysis.

Similar to the Classical approach, ML optimization algorithm would be adopted that enables the use of likelihood ratio test in determining the number of factors, K. An EFA would be performed first to provide insights for a plausible model. By combining expertise and the insights obtained from the EFA, the model can be refined by using Confirmatory Factor Analysis (**CFA**). While working on a CFA, it is the researcher's discretion to determine which parameters are to be estimated and which are to be constrained at some specified value.

A model can be further revised with reference to the Modification Index (**M.I.**) that is available in the LISREL. This index is a value of the estimated improvement for the present model if a constrained parameter is released. A large value of M.I. indicates that the model can have a better fit if the corresponding parameter is liberated.

4.4 Merit of the SEM Approach

As the SEM approach merges a two-stage estimation process into one, it not only makes the estimation procedure become more efficient but also solves many problems that are concealing in the Classical method. The most critical problem that has been solved is the EIV problem. The factor loadings $b_1, \ldots, b_K$ are no longer treated as explanatory variables in the SEM approach; instead they are estimated simultaneously with the risk premium $\lambda_1, \ldots, \lambda_K$. As a result, path coefficients modeled in the SEM are unbiased by error terms, whereas the regression coefficients are not.

Besides, it enables the validity test for the overall model but not only the CSR model. There are certain indices concerning the validity of a LISREL model. In accordance with the goodness-of-fit indices provided for the combined model, both the factor model and the pricing equation can be assessed simultaneously. Thereby, the whole estimated model can be further modified. Amongst all indices for refining a LISREL model, M.I. is the most popular one. It is a measure of predicted decrease in χ^2 if one of the constrained parameters is relaxed and the whole model is re-estimated. Yet, a drop in χ^2 signifies an improvement in the goodness-of-fit. Hence, the overall model can be modified accordingly by relaxing the constrained parameter that possesses a large M.I.. But it is recommended to relax one constrained parameter at one time so as to realize the induced improvement of the fit.

Last but not the least, since CFA is employed in the SEM, expertise and information avaliable in the capital market can be incorporated in the LISREL model. Resultant estimates would be much reliable and the whole model can better describe the reality, therefore the estimated model would possess much interpretative value. One of the most popular information that would aid in modeling is the relaxation of error covariances among several securities. For instance, a specific-industry factor would exist for certain securities that belong to the same industry; however this kind of influence cannot be counted as a global impact. In that case, it is logical to set the corresponding error covariances free for estimation.

Learning the apparent and vital merits of the SEM approach over the Classical one, differences between these two methodologies would be further examined in the next chapter.

Chapter 5

Simulation Study

Intuitive excellence of the SEM approach over the Classical one has been revealed in the previous chapter. An in-depth exploration for the difference between the two methodologies would be conducted based on a simulation study. Comparison for parameter estimates under the two approaches can be made when each of the parameters alters in different designs.

5.1 Simulation Design

Eight variables and three factors are proposed in our simulation study. For the sake of generalization, the first factor f_1 is considered to be a general factor for the underlying variables, possessing 0.5 covariance with each of the other factors. On the contrary, the other two factors f_2 and f_3 have influence only to the first four and last four variables respectively.

With the aid of IMSL Fortran subroutine, multivariate normally distributed errors and factors are generated according to the following equation:

$$r_i = r_f + b_{i1}(f_1 + \lambda_1) + b_{i2}(f_2 + \lambda_2) + b_{i3}(f_3 + \lambda_3) + \varepsilon_i \qquad \text{for } i = 1, \ldots, 8. \quad (5.1)$$

For simplicity, a fixed diagonal error covariance matrix $\Theta_\varepsilon = \text{diag}(0.5)_{8\times 8}$ is considered.

Originally, 100 replications were generated for each design. But in view of the existence of a few non-convergent solutions occurred under the SEM approach, 10 additional replications are generated. Thus, 110 replications are simulated for each design ultimately. For the SEM method, the number of converged solutions is close to 100 after eliminating those being non-converged; however, it is not the case under the Classical approach. Therefore, the number of converged cases in each circumstances will be reported as well.

Designs are then constructed accordingly through varying the risk premium vector λ, the risk-free rate r_f, the factor loading matrix B, the factor covariance matrix Φ and the sample size T.

For analogy to the reality, the risk-free rate is generated to have a small value while all risk premium are considered to be positive. In general, two sets of factor risk premium and risk-free rate are studied, they are

$$\lambda^{(1)} = (1, 3, 5)^T \qquad \text{and} \qquad \lambda^{(2)} = (1, 3, 0)^T$$

$$r_f^{(1)} = 0.05 \qquad \text{and} \qquad r_f^{(2)} = 0.1$$

where the superscript is the label for each setting.

As mentioned in the previous chapter, the risk-free rate is required to be fixed in order to set up a concrete metric; whereas the risk premium is free for estimation.

On the other hand, three specific factor covariance matrices are constructed. Covariances between the general factor and the other two factors would be fixed to be 0.5 in all designs. By comparing the three settings, they differ in the factor variances (i.e. ϕ_{11}, ϕ_{22} and ϕ_{33}) and the covariance between the two specific factors (i.e. ϕ_{32} and ϕ_{23}). The ultimate set up is as follow:

$$\Phi^{(1)} = \begin{pmatrix} \phi_{11}(fixed) & \phi_{12} & \phi_{13} \\ \phi_{21}(fixed) & \phi_{22} & \phi_{23} \\ \phi_{31}(fixed) & \phi_{32} & \phi_{33} \end{pmatrix} = \begin{pmatrix} 1.0 & 0.5 & 0.5 \\ 0.5 & 3.0 & 0.5 \\ 0.5 & 0.5 & 5.0 \end{pmatrix},$$

$$\Phi^{(2)} = \begin{pmatrix} \phi_{11}(fixed) & \phi_{12} & \phi_{13} \\ \phi_{21}(fixed) & \phi_{22} & \phi_{23} \\ \phi_{31}(fixed) & \phi_{32} & \phi_{33} \end{pmatrix} = \begin{pmatrix} 1.0 & 0.5 & 0.5 \\ 0.5 & 1.0 & 0.5 \\ 0.5 & 0.5 & 1.0 \end{pmatrix}$$

and

$$\Phi^{(3)} = \begin{pmatrix} \phi_{11}(fixed) & \phi_{12} & \phi_{13} \\ \phi_{21}(fixed) & \phi_{22} & \phi_{23} \\ \phi_{31}(fixed) & \phi_{32} & \phi_{33} \end{pmatrix} = \begin{pmatrix} 1.0 & 0.5 & 0.5 \\ 0.5 & 1.0 & 0.0 \\ 0.5 & 0.0 & 1.0 \end{pmatrix}.$$

Particularly, the design $\Phi^{(1)}$ is the most general case. It corresponds to a situation where the variance for each of the factors differs substantially and all factors are correlated in some way. The second design $\Phi^{(2)}$ is the case where all factors possess similar variation, with all factors being correlated. While the last one is the simplest case, in which the two specific factors f_1 and f_2 are uncorrelated and the variation for all factors are equivalent.

However, factors may not be identified when any general factor exists. In order to solve this problem, variance of the general factor ϕ_{11} and its covariance with the other two factors, ϕ_{21} and ϕ_{31}, would be fixed.

While the impact on the estimation caused by the change in factor loading is an unknown. Thereby, two setting $B^{(1)}$ and $B^{(2)}$ are constructed. They are constructed by varying the elements corresponding to the general factor as follow:

$$B^{(1)} = \begin{pmatrix} b_{11} & b_{12}(\text{ref}) & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \\ b_{41} & b_{42} & b_{43} \\ b_{51} & b_{52} & b_{53}(\text{ref}) \\ b_{61} & b_{62} & b_{63} \\ b_{71} & b_{72} & b_{73} \\ b_{81}(\text{ref}) & b_{82} & b_{83} \end{pmatrix} = \begin{pmatrix} 0.65 & 1.00 & 0.00 \\ 0.70 & 0.60 & 0.00 \\ 0.75 & 0.70 & 0.00 \\ 0.80 & 0.80 & 0.00 \\ 0.85 & 0.00 & 1.00 \\ 0.90 & 0.00 & 0.20 \\ 0.95 & 0.00 & 0.30 \\ 1.00 & 0.00 & 0.40 \end{pmatrix}$$

and

$$B^{(2)} = \begin{pmatrix} b_{11} & b_{12}(\text{ref}) & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \\ b_{41} & b_{42} & b_{43} \\ b_{51} & b_{52} & b_{53}(\text{ref}) \\ b_{61} & b_{62} & b_{63} \\ b_{71} & b_{72} & b_{73} \\ b_{81}(\text{ref}) & b_{82} & b_{83} \end{pmatrix} = \begin{pmatrix} 0.30 & 1.00 & 0.00 \\ 0.35 & 0.60 & 0.00 \\ 0.40 & 0.70 & 0.00 \\ 0.45 & 0.80 & 0.00 \\ 0.50 & 0.00 & 1.00 \\ 0.55 & 0.00 & 0.20 \\ 0.60 & 0.00 & 0.30 \\ 0.65 & 0.00 & 0.40 \end{pmatrix}.$$

The first, fifth and the eighth variable are selected to be the reference variables for factors f_2, f_3 and f_1 respectively, as they possess the maximal value of loading for the concerned factors. Thereby, metric for every factor can be created in both estimation methods. Specifically, it is accomplished by fixing the rows of loading matrix that correspond to the selected reference variables. While CFA is employed under the SEM framework, therefore the zero entries in the factor loading matrix (i.e. b_{23}, b_{33}, b_{43}, b_{62}, b_{72} and b_{82}) would be fixed to their true values in the mean time.

Different combinations corresponding to the above-cited settings would be studied. The degree of accuracy would be compared between different estimation methods and different designs according to the following three different sample sizes.

$$T^{(1)} = 2000, \qquad T^{(2)} = 500 \qquad \text{and} \qquad T^{(3)} = 200$$

Basically, 72 designs are generated. Then the following statistics for each parameter estimates would be computed to study their precision in a statistical point of view. They are:

- Sample mean of the 110 estimates $= \frac{1}{110}\sum_{r=1}^{110}(\text{estimated value})$
- Bias of the sample estimates = Sample mean - True value
- S.D. ratio $= \frac{\text{Standard deviation of the 110 estimates}}{\text{Average of the 110 produced standard deviation}}$

- Root Mean Square Error (**RMSE**)
$= \sqrt{\frac{1}{110}\sum_{r=1}^{110}(\text{estimated value} - \text{true value})^2}$

The detailed configuration of the simulation and the computed statistics are tabulated in Appendix A.

Then, LISREL is employed to perform analysis. Though starting values can be generated in LISREL, they are provided in the present study to save computation time.

5.2 Insight from the Simulation Study

From the calculated statistics in the simulation study, findings are yielded when each of the following parameters varies, with other things remain unchanged.

5.2.1 Factor loading, B

For the two designs of factor loading matrix, they make no difference for the performance of estimates. As expected, the SEM approach would produce factor loadings with higher accuracy as less parameters are involved. It means that the magnitude of loadings does not have substantial influence in the estimation process.

5.2.2 Factor covariance matrix, Φ

On the other hand, peculiar findings are observed when the factor covariance matrix varies. By observation, the most general design $\Phi^{(1)}$ results in less non-convergent solutions under both methodologies. This circumstance is much pronounced in the Classical approach and in cases when sample size is small. The formation of this unexpected finding maybe caused by the way in identifying factors.

Meanwhile, estimates appear far much accurate under the design of $\Phi^{(1)}$ comparatively. While the fall of precision appears considerably obvious for the parameter $\widehat{\lambda}$, when RMSE is compared. Among λ_1, λ_2 and λ_3, this impact is much acute for the risk premia corresponding to the general factor $\widehat{\lambda}_1$, especially when the Classical approach is adopted. On the other hand, RMSE of ϕ_{ij} slightly increases when its value increases. Yet, it is an expected event.

5.2.3 Risk-free rate, r_f

As stated before, the risk-free rate r_f will be fixed to its true value in both estimation methods. For the Classical approach, it is particularly accomplished by subtracting r_f from the sample mean of return before performing the CSR. Yet, no discrepancy in precision is found when its value changes from 0.05 to 0.10 for both methodologies. For instance, designs A1 and A3 possess same parameter setting, except r_f. Though r_f has changed from 0.05 to 0.1, it does not alter the performance of the parameter estimates.

While it is assumed that the risk-free rate can be correctly specified, this is not always the case. Based on the setting $\Phi^{(1)}$, $B^{(2)}$, 12 additional designs are constructed to examine the resulting estimates when r_f is misspecified. To conform with the reality, the misspecified value of r_f is considered to be a small one as well. Performance of estimates for each of the following scenarios would be reviewed:

- when the true r_f is 0.05 but we fix it at 0.1.
- when the true r_f is 0.1 but we fix it at 0.05.

Designs A25 to A28, B25 to B28 and C25 to C28 in Appendix A correspond to the situation when r_f is misspecified for different sample sizes. Parallel to the above cases, A13 to A16, B13 to B16 and C13 to C16 are the designs when r_f is correctly specified with other things remain unchanged. Therefore, comparisons can be made accordingly.

Theoretically, the change of r_f would affect each of the estimates since it plays a role in the optimization algorithm. Its role in the SEM approach has been shown by τ in (4.6), whereas its role under the Classical approach is

$$\widehat{\lambda} = (\widehat{B}^T \widehat{B})^{-1} \widehat{B}^T (\bar{r} - r_f 1).$$

However, the change in r_f is so small that it causes no obvious difference in parameter estimates under both estimation methods, even though it has been misspecified.

5.2.4 Risk premium, λ

Another erratic finding is the drop of precision for $\widehat{\lambda}$ when the setting of risk premium changes from $\lambda^{(2)} = (1,3,0)^T$ to $\lambda^{(1)} = (1,3,5)^T$. It is revealed in the RMSE for the corresponding risk premium in designs A1 to A24, B1 to B24 and C1 to C24. This increasing trend in RMSE is much evident for the factor covariance design $\Phi^{(2)}$ and $\Phi^{(3)}$. Therefore, further study is set up based on the design of $B^{(2)}$, ${r_f}^{(1)}$ and $T^{(1)}$ by varying the value of λ_3 gradually for different design of Φ. Results for these designs are tabulated in A29 to A43.

It is also found that the RMSE of λ increases with the value of λ_3 in both estimation methodologies. But under the Classical approach, the increase of RMSE is comparatively large to the increase of λ_3. In contrast, this increase is not obvious when the SEM approach is employed. Result corresponding to the design A39-A43 gives one illustration. With the application of the Classical approach, the RMSE of $\widehat{\lambda}_1$ increases from 1.3636 to 4.3969 when λ_3 increases from 0.5 to 4.5. On the contrary, the RMSE of $\widehat{\lambda}_1$ only increases from 0.0341 to 0.1293 under the SEM approach. Among the three risk premium derived from the Classical method, λ_1 is comparatively poor estimated. It is revealed in its associated large bias and RMSE. The above problem is much obvious for the settings $\Phi^{(2)}$ and $\Phi^{(3)}$.

Besides, the S.D. ratio corresponding to each parameter are compared between the two estimation methods. Standard deviation of λ is found to be seriously underestimated in the Classical approach. Specifically, an underestimated standard deviation would be revealed in a large S.D. ratio that is deviating from one.

Hypothesis testing becomes considerably unreliable, since it tends to justify the significance of factors but in fact they may not be so.

In general, the S.D. ratios deriving from the SEM approach are close to one in comparison to those obtained from the Classical method. This nice property preserves even when the sample size drops from 2000 to 200. Therefore, tests regarding a presumed pricing factor becomes trustworthy if SEM approach is employed.

5.2.5 Sample size, T

When sample size decreases, it is undoubtedly that accuracy of estimates would drop, and hence a rise in RMSE. Besides, a drop in sample size results in more non-convergent solution. These degenerative phenomena appear much evident when the Classical method is employed.

5.2.6 Other findings

While constraints for a positive error covariance is not provided in LISREL, heywood case may result in which negative error variance occurs. In the present study, negative values of $\widehat{\Theta}_{\varepsilon}$ are found in designs C2, C12, C14, C18, C22, C24 and C26.

Yet, it is a limitation of the software but not the theory itself. Other software may be able to tackle this problem by implementing constraints in forming a positive definite matrix. Indeed, softwares apart from LISREL such as EQS can be utilized to estimate a SEM with inequality constraints.

Chapter 6

Empirical Study

An empirical study is carried out so as to illustrate the application of the methods in practice. Meanwhile, the mechanism and the resultant model between the two approaches can be acquainted too.

6.1 Specification of the Data

Taking the duration of the available series and pertinence into consideration, 25 out of 33 Hang Seng Index constituents are selected. Their prices are obtained from the Datastream that is owned by Thomson Financial Limited (*http://www.thomsonfinancial.com*). The selected stocks and the sectors that they belong are tabulated in Table 6.1.

Table 6.1: Stocks for analysis

Sector	Stocks			
HSNF	HSBC (x_1)	Hang Seng Bank (x_2)	BEA (x_3)	
HSNU	CLP Holdings (x_4)	HK&China Gas (x_5)	HK Electric. (x_6)	
HSNP	Cheung Kong (x_7)	Henderson Land (x_8)	SHK PPT (x_9)	
	Wheelock (x_{10})	Henderson Inv. (x_{11})	Hang Lung PPT (x_{12})	
	Wharf Holdings (x_{13})	Hutchison (x_{14})	Swire Pacific A (x_{15})	
	Johnson Elec. H. (x_{16})	Citic Pac. (x_{17})	China Resources (x_{18})	
HSNC	Cathay Pac. Air (x_{19})	Esprit Holdings (x_{20})	Li&Fung (x_{21})	
	TVB (x_{22})	Yue Yuen Ind. (x_{23})	Legend Group (x_{24})	Cosco Pacific (x_{25})

Weekly data from 30 December 1994 to 27 December 2002 is utilized, not just because of its less fluctuation in comparison to daily data but also the availability of sufficient data points for analysis in contrast to the use of monthly data.

Percentage of return ($r_{i,t} \times 100\%$) would be analyzed, in which return for each of the stocks is computed by

$$r_{i,t} = \frac{P_{i,t} - P_{i,t-1} + D_{i,t}}{P_{i,t-1}}$$

where $P_{i,t}$ stands for the stock price of security-i at time t and $D_{i,t}$ is the dividend payment per share at the period ended at time t. Finally, 418 data points are computed and input for analysis.

6.2 Procedures for the SEM Approach

The SEM approach starts with an EFA that aids to determine the number of factors as well as the setup of a metric. A CFA would be carried out thereafter and the model would be further amended if necessary.

EFA of the SEM Approach

With the aid of PRELIS affiliated to LISREL, a ML factor analysis is performed at first. The accompanying LR test suggests that five factors being substantial for the stocks under study. Particularly, a Two-stage Least-squares (**TS-LS**) is conducted. It provides some initial estimates that facilitate factors identification and screening of reference variables for the underlying factors.

Through inspecting the pattern of the factor loading matrix, the five factors are identified as the sectional factors. They are the Finance (**HSNF**), Utilities (**HSNU**), Property (**HSNP**), Commercial and industrial (**HSNC**) sectional factors and the Hang Seng Index (**HSI**). But notice that HSI is a general factor which would correlate with other factors conceptually.

On the other hand, the stock that loads most heavily on an unobserved factor will be selected as its reference variable. Thereby it allows the stock to anchor the meaning of that unobserved factor. Selected reference variables and their values are tabulated in Table 6.2.

Table 6.2: Selected reference variables

Factor	Reference variable	Reference value
HSNF	Hang Seng Bank (x_2)	1.812
HSNU	HK Electric. (x_6)	2.516
HSNP	SHK PPT (x_9)	5.741
HSNC	Cosco Pacific (x_{25})	5.706
HSI	Cheung Kong (x_7)	5.065

Since each of the stocks are supposed to load on its own sectional factor and the general factor, HSI. A secondary EFA is performed to seize the necessity to free extra entries in the factor loading matrix, apart from their own sectional factor and the HSI. Value of the reference variables is fixed to that value obtained from TS-LS, while all other parameters are free for estimation. But an prerequisite interpretative sense should be justified for every looseness.

CFA of the SEM Approach

Consolidating the above preliminary result, then available information is sought to implement a CFA.

Since factors have been projected onto some economic fundamentals, corresponding information can be imported. Values of the factor indices are obtained from Datastream in compliance with the time period under study. Therefore, returns of the factors in percentage can be computed and the corresponding factor covariance matrix can be obtained. The result is

$$\Phi = \begin{array}{r} \text{HSNF} \\ \text{HSNU} \\ \text{HSNP} \\ \text{HSNC} \\ \text{HSI} \end{array} \begin{pmatrix} 15.4197 & & & & \\ 6.2674 & 9.8654 & & & \\ 15.6938 & 7.8459 & 27.1080 & & \\ 13.1941 & 6.9666 & 20.5226 & 22.5693 & \\ 13.3915 & 7.0666 & 18.5970 & 17.6632 & 15.4880 \end{pmatrix}. \tag{6.1}$$

Making use of this factor covariance matrix, then factors can be identified through fixing the variance of HSI and its covariance with other factors. These variance and covariances estimates based on historical data are readily computed from (6.1).

Generally speaking, a weekly deposit rate can be regarded as a riskless rate of return. Percentage of weekly deposit rate in Hong Kong is acquired from the Datastream, in accordance to the time period under study. Then the average of this series of data, which equals to 0.0495, would be fixed as the risk-free rate of return.

Yet, certain stocks are known to be correlated among themselves. Their effect is believed to be vital in explaining the co-movement of stock prices, although they are not pervasive. Therefore, error covariances tabulated in Table 6.3 would be free for estimation to capture this kind of specific effect.

Table 6.3: Firm-specific error covariances

Stocks	Notation
HSBC, Hang Seng Bank	$\Theta_\varepsilon(1,2)$
HK&China Gas, Henderson Land, Henderson Inv.	$\Theta_\varepsilon(5,8)$, $\Theta_\varepsilon(5,11)$, $\Theta_\varepsilon(8,11)$
Cheung Kong, Hutchison, HK Electric .	$\Theta_\varepsilon(6,7)$, $\Theta_\varepsilon(6,14)$, $\Theta_\varepsilon(8,14)$
Wharf Holdings, Wheelock	$\Theta_\varepsilon(13,10)$
Cathay Pac. Air, Swire Pacific A, Citic Pac.	$\Theta_\varepsilon(15,17)$, $\Theta_\varepsilon(15,19)$, $\Theta_\varepsilon(17,19)$

Afterall, CFA is performed with all the above available information being incorporated in accordance with equation(4.7). However, the resultant model is still subject to further revision. Constrained parameter with large M.I. would be released one at a time, provided that it is reasonable to do so. Certain goodness-of-fit indices would be considered as indicators to cease further adjustment since perfect-fit is not the aim in constructing a model.

The Goodness-of-fit index (**GFI**) is a popular index. It represents the percentage of observed covariances explained by the covariance implied by the model. Hence a large GFI indicates a good fit. Under the ML algorithm, GFI can be expressed as

$$\text{GFI} = 1 - \frac{Tr(\widehat{\Sigma}^{-1}(S - \widehat{\Sigma})^2)}{Tr[(\widehat{\Sigma}^{-1}S)^2]}$$

where $\widehat{\Sigma}$ and S are the fitted covariance matrix and sample covariance matrix respectively.

Another index is the Adjusted GFI (**AGFI**). Actually, it equals to the GFI but adjusted for the degrees of freedom. It is given by

$$\text{AGFI} = 1 - \frac{n(n+1)}{2(df)}(1 - GFI)$$

where n and df denote the number of variables and the degrees of freedom respectively. As a rule of thumb in usual practice, both GFI and AGFI should be greater than 0.9 for a acceptable fit.

Two more indices that are less affected by sample size would be considered. The first one is the Non-normed Fit Index (**NNFI**). It reflects the proportion by which the researcher's model improves the goodness-of-fit in comparison to the null model. Its formula is

$$\text{NNFI} = \frac{\chi^2{}_{Null}/df_{Null} - \chi^2{}_{Model}/df_{Model}}{\chi^2{}_{Null}/df_{Null} - 1}$$

where $\chi^2{}_{Null}$ and $\chi^2{}_{Model}$ denote the χ^2 statistic for a unconstrained model and the specified model respectively. Another one is the Root Mean Square Error of Approximation (**RMSEA**). Instead of making comparison with a null model, RMSEA computes the average lack of fit per degree of freedom by

$$\text{RMSEA} = \sqrt{\frac{\chi^2{}_{Model}}{df_{Model}} - \frac{1}{n-1}}.$$

Hu and Bentler (1999) suggested that a good-fit model should have a NNFI $\geq$ 0.95 and a RMSEA ≤ 0.06.

A model can be claimed to have a good fit if all kind of goodness-of-fit indices give a consistent justification for the model. If contradicting conclusions are implied from different indices, the sufficiency of the fit would be suspected. Therefore, the basic model would be refined until all of the above indices have attained their cutoff values. In the present study, it is achieved after setting the error covariance between Johnson Electric and Li&Fung $\Theta_{\varepsilon}(16, 21)$, and the error covariance between the Hang Seng Bank and BEA $\Theta_{\varepsilon}(2, 3)$ free for estimation. Value of the resultant model and the goodness-of-fit indices are provided in Appendix B, while the LISREL input codes for the analysis is given in Appendix C. As the percentages of stock returns are provided as raw data for LISREL analysis, both the sample mean and sample covariance can be computed accordingly. Moreover, method of covariance analysis is specified for the estimation process.

6.3 Procedures for the Classical Approach

Based on the same dataset, the Classical approach would be demonstrated likewise. The preliminary result obtained from the SEM approach would be utilized instead. Hence five factors are specified in the factor model below.

EFA of the Classical Approach

Factors are identified through fixing the variance of HSI and its covariances with other factors to their estimates obtained from historical values. Value of the reference variables would be fixed as those stated in Table 6.2; but its loading corresponding to the HSI and the loading for the remaining variables would be free for estimation.

CSR of the Classical Approach

Presuming the correct specification of the factor model, CSR is carried out afterwards. Again, average of the weekly deposit rates would be treated as the risk-free rate. Then sample mean of the stock return with the risk-free rate subtracted, is regressed on the estimated factor loadings that are obtained from the previous stage.

6.4 Model Interpretation

The estimated factor loading, factor covariance matrix and risk premium from the two methods are tabulated in Appendix B.

Estimate that of great concerned is the risk premium $\widehat{\lambda}$. It is observed that $\widehat{\lambda}_i$, $i = 1, \ldots, 5$ and their significance are considerably dissimilar between the two approaches. The estimated risk premium corresponding to HSNU and HSNC obtained from the SEM approach are found to be significant at a 95% confidence level. On top of it, all of the risk premium are found to be positive in the SEM approach. However $\widehat{\lambda}$ looks unreasonable in the Classical approach, in which most of them are negative in value. As mentioned before, the existence of the EIV problem and the under-estimated standard deviation of risk premium are concealing in the Classical method, therefore the resulting estimates are not reliable. Hence, model interpretation is only provided for the solution obtained from the SEM approach.

For stocks belonging to the property sector, most of them load heavily on the finance factor as well. This result is logical, since the finance and the property industries in Hong Kong are highly correlated indeed.

On the other hand, many elements in the error covariance matrix in Appendix B.4 are significant. Though some covariance terms are not significant in a statistical sense, they should be free for estimation so as to reflect the realistic situation.

Apart from the aforementioned model indices, the square multiple correlation (**SMC**) can be examined as well. It reflects the adequateness of the presumed relationship between each indicator and unobserved factors. The SMC for the i^{th} observed variable is

$$SMC_i = 1 - \frac{\widehat{\theta}_{ii}}{\widehat{\sigma}_{ii}}$$

where $\widehat{\theta}_{ii}$ and $\widehat{\sigma}_{ii}$ are the estimated error variance and the observed variance for the i^{th} variable respectively.

SMC gives the percentage of the variance in the independent indicators that can be attributed to the unobserved factors rather than to the measurement error. Hence the reliability for each observed indicator can be assessed. The value of SMC is between 0 and 1. Therefore, for a well-specified model, each indicator should associate with a large SMC.

In the present empirical study under the SEM approach, values of the SMC are over 0.5 on average except for stocks belonging to the commercial sector. It indicates that the stocks under study serve fairly well as measurement instruments for the unobserved factors.

6.5 Difficulties Encountered

Nevertheless, certain difficulties have come across in model construction.

Actually, there are other ways to identify the model and the underlying factors. But the variation of the stock data is so large that convergent solution is not easy to obtain. The diagonal of the factor covariance matrix has once been fixed as one as a trial. However, this method does not work for the stock data under study. It can be mainly ascribed to the inconsistent variation across the factors. Moreover, factors must be identified in order to get an identified model. However, the presence of the general factor causes the factor identification process complicated. Thereby, the corresponding model becomes difficult to be identified. Actually, the difficulty in model identification not just occurs in the SEM approach; same problem is also encountered in the Classical method.

Model refining is another complicated procedure. It is not always appropriate to release a parameter which possesses the greatest M.I.. Instead, interpretative sense should be considered at the same time. In some cases, relaxing one parameter with large M.I. and root to the reality sense may result in non-converging estimates at last. Different trials are needed in every revising step in order to get a reasonable model with convergent solution.

Nevertheless, every model building technique would face similar difficulties. They are not unique to the SEM method. But the most formidable problem, factor identification, has been fixed under the application of SEM approach.

Chapter 7

Conclusion and Discussion

In this thesis, the SEM approach has shown to be superior than the Classical method. The critical problems, such as the EIV problem and the testability have been settled under the SEM methodology.

From the results of the simulation study, it is found that estimates under the Classical method are less precise than those under the SEM approach. This circumstance is extraordinary pronounced for the estimate of risk premium. Moreover, standard deviation of the risk premium are found to be enormously underestimated, which conforms the severity of the EIV problem being suspected by many researchers. More surprisingly, there is a remarkable increase in RMSE of risk premium when the deviation of λ_3 from zero is increased slightly. Though the RMSE of the risk premium estimates derived from the SEM approach seems to have this increasing trend also, they are not obvious in general.

While to the stance of economists, model estimated by the SEM approach is worthy in the sense that it possesses an interpretative value grounded on the reality.

In consideration of the premises, the SEM methodology enable further development of the APT theory in many aspects. The non-linearity factor model is one possible direction. Yet, the area for further research is much broader than generalizing the factor model solely. With the use of the SEM approach, the evolution of the theory can be accelerated.

Appendix A

Result of the Simulation Study

Table A.1: Configuration of the Simulation Study

Design	Sample size	Factor loading matrix	Factor covariance matrix	True risk-free rate	Specified risk-free rate	Risk premium
A1	2000	$B^{(1)}$	$\Phi^{(1)}$	0.05	0.05	$\lambda^{(1)}$
A2	2000	$B^{(1)}$	$\Phi^{(1)}$	0.05	0.05	$\lambda^{(2)}$
A3	2000	$B^{(1)}$	$\Phi^{(1)}$	0.10	0.10	$\lambda^{(1)}$
A4	2000	$B^{(1)}$	$\Phi^{(1)}$	0.10	0.10	$\lambda^{(2)}$
A5	2000	$B^{(1)}$	$\Phi^{(2)}$	0.05	0.05	$\lambda^{(1)}$
A6	2000	$B^{(1)}$	$\Phi^{(2)}$	0.05	0.05	$\lambda^{(2)}$
A7	2000	$B^{(1)}$	$\Phi^{(2)}$	0.10	0.10	$\lambda^{(1)}$
A8	2000	$B^{(1)}$	$\Phi^{(2)}$	0.10	0.10	$\lambda^{(2)}$
A9	2000	$B^{(1)}$	$\Phi^{(3)}$	0.05	0.05	$\lambda^{(1)}$
A10	2000	$B^{(1)}$	$\Phi^{(3)}$	0.05	0.05	$\lambda^{(2)}$
A11	2000	$B^{(1)}$	$\Phi^{(3)}$	0.10	0.10	$\lambda^{(1)}$
A12	2000	$B^{(1)}$	$\Phi^{(3)}$	0.10	0.10	$\lambda^{(2)}$
A13	2000	$B^{(2)}$	$\Phi^{(1)}$	0.05	0.05	$\lambda^{(1)}$
A14	2000	$B^{(2)}$	$\Phi^{(1)}$	0.05	0.05	$\lambda^{(2)}$
A15	2000	$B^{(2)}$	$\Phi^{(1)}$	0.10	0.10	$\lambda^{(1)}$
A16	2000	$B^{(2)}$	$\Phi^{(1)}$	0.10	0.10	$\lambda^{(2)}$
A17	2000	$B^{(2)}$	$\Phi^{(2)}$	0.05	0.05	$\lambda^{(1)}$
A18	2000	$B^{(2)}$	$\Phi^{(2)}$	0.05	0.05	$\lambda^{(2)}$
A19	2000	$B^{(2)}$	$\Phi^{(2)}$	0.10	0.10	$\lambda^{(1)}$
A20	2000	$B^{(2)}$	$\Phi^{(2)}$	0.10	0.10	$\lambda^{(2)}$
A21	2000	$B^{(2)}$	$\Phi^{(3)}$	0.05	0.05	$\lambda^{(1)}$
A22	2000	$B^{(2)}$	$\Phi^{(3)}$	0.05	0.05	$\lambda^{(2)}$
A23	2000	$B^{(2)}$	$\Phi^{(3)}$	0.10	0.10	$\lambda^{(1)}$
A24	2000	$B^{(2)}$	$\Phi^{(3)}$	0.10	0.10	$\lambda^{(2)}$

Design	Sample size	Factor loading matrix	Factor covariance matrix	True risk-free rate	Specified risk-free rate	Risk premium
A25	2000	$B^{(2)}$	$\Phi^{(1)}$	0.05	0.10	$\lambda^{(1)}$
A26	2000	$B^{(2)}$	$\Phi^{(1)}$	0.05	0.10	$\lambda^{(2)}$
A27	2000	$B^{(2)}$	$\Phi^{(1)}$	0.10	0.05	$\lambda^{(1)}$
A28	2000	$B^{(2)}$	$\Phi^{(1)}$	0.10	0.05	$\lambda^{(2)}$
A29	2000	$B^{(1)}$	$\Phi^{(1)}$	0.05	0.05	$(1, 3, 0.5)^T$
A30	2000	$B^{(1)}$	$\Phi^{(1)}$	0.05	0.05	$(1, 3, 1.5)^T$
A31	2000	$B^{(1)}$	$\Phi^{(1)}$	0.05	0.05	$(1, 3, 2.5)^T$
A32	2000	$B^{(1)}$	$\Phi^{(1)}$	0.05	0.05	$(1, 3, 3.5)^T$
A33	2000	$B^{(1)}$	$\Phi^{(1)}$	0.05	0.05	$(1, 3, 4.5)^T$
A34	2000	$B^{(1)}$	$\Phi^{(2)}$	0.05	0.05	$(1, 3, 0.5)^T$
A35	2000	$B^{(1)}$	$\Phi^{(2)}$	0.05	0.05	$(1, 3, 1.5)^T$
A36	2000	$B^{(1)}$	$\Phi^{(2)}$	0.05	0.05	$(1, 3, 2.5)^T$
A37	2000	$B^{(1)}$	$\Phi^{(2)}$	0.05	0.05	$(1, 3, 3.5)^T$
A38	2000	$B^{(1)}$	$\Phi^{(2)}$	0.05	0.05	$(1, 3, 4.5)^T$
A39	2000	$B^{(1)}$	$\Phi^{(3)}$	0.05	0.05	$(1, 3, 0.5)^T$
A40	2000	$B^{(1)}$	$\Phi^{(3)}$	0.05	0.05	$(1, 3, 1.5)^T$
A41	2000	$B^{(1)}$	$\Phi^{(3)}$	0.05	0.05	$(1, 3, 2.5)^T$
A42	2000	$B^{(1)}$	$\Phi^{(3)}$	0.05	0.05	$(1, 3, 3.5)^T$
A43	2000	$B^{(1)}$	$\Phi^{(3)}$	0.05	0.05	$(1, 3, 4.5)^T$

Design	Sample size	Factor loading matrix	Factor covariance matrix	True risk-free rate	Specified risk-free rate	Risk premium
B1	500	$B^{(1)}$	$\Phi^{(1)}$	0.05	0.05	$\lambda^{(1)}$
B2	500	$B^{(1)}$	$\Phi^{(1)}$	0.05	0.05	$\lambda^{(2)}$
B3	500	$B^{(1)}$	$\Phi^{(1)}$	0.10	0.10	$\lambda^{(1)}$
B4	500	$B^{(1)}$	$\Phi^{(1)}$	0.10	0.10	$\lambda^{(2)}$
B5	500	$B^{(1)}$	$\Phi^{(2)}$	0.05	0.05	$\lambda^{(1)}$
B6	500	$B^{(1)}$	$\Phi^{(2)}$	0.05	0.05	$\lambda^{(2)}$
B7	500	$B^{(1)}$	$\Phi^{(2)}$	0.10	0.10	$\lambda^{(1)}$
B8	500	$B^{(1)}$	$\Phi^{(2)}$	0.10	0.10	$\lambda^{(2)}$
B9	500	$B^{(1)}$	$\Phi^{(3)}$	0.05	0.05	$\lambda^{(1)}$
B10	500	$B^{(1)}$	$\Phi^{(3)}$	0.05	0.05	$\lambda^{(2)}$
B11	500	$B^{(1)}$	$\Phi^{(3)}$	0.10	0.10	$\lambda^{(1)}$
B12	500	$B^{(1)}$	$\Phi^{(3)}$	0.10	0.10	$\lambda^{(2)}$
B13	500	$B^{(2)}$	$\Phi^{(1)}$	0.05	0.05	$\lambda^{(1)}$
B14	500	$B^{(2)}$	$\Phi^{(1)}$	0.05	0.05	$\lambda^{(2)}$
B15	500	$B^{(2)}$	$\Phi^{(1)}$	0.10	0.10	$\lambda^{(1)}$
B16	500	$B^{(2)}$	$\Phi^{(1)}$	0.10	0.10	$\lambda^{(2)}$
B17	500	$B^{(2)}$	$\Phi^{(2)}$	0.05	0.05	$\lambda^{(1)}$
B18	500	$B^{(2)}$	$\Phi^{(2)}$	0.05	0.05	$\lambda^{(2)}$
B19	500	$B^{(2)}$	$\Phi^{(2)}$	0.10	0.10	$\lambda^{(1)}$
B20	500	$B^{(2)}$	$\Phi^{(2)}$	0.10	0.10	$\lambda^{(2)}$
B21	500	$B^{(2)}$	$\Phi^{(3)}$	0.05	0.05	$\lambda^{(1)}$
B22	500	$B^{(2)}$	$\Phi^{(3)}$	0.05	0.05	$\lambda^{(2)}$
B23	500	$B^{(2)}$	$\Phi^{(3)}$	0.10	0.10	$\lambda^{(1)}$
B24	500	$B^{(2)}$	$\Phi^{(3)}$	0.10	0.10	$\lambda^{(2)}$
B25	500	$B^{(2)}$	$\Phi^{(1)}$	0.05	0.10	$\lambda^{(1)}$
B26	500	$B^{(2)}$	$\Phi^{(1)}$	0.05	0.10	$\lambda^{(2)}$
B27	500	$B^{(2)}$	$\Phi^{(1)}$	0.10	0.05	$\lambda^{(1)}$
B28	500	$B^{(2)}$	$\Phi^{(1)}$	0.10	0.05	$\lambda^{(2)}$

Design	Sample size	Factor loading matrix	Factor covariance matrix	True risk-free rate	Specified risk-free rate	Risk premium
C1	200	$B^{(1)}$	$\Phi^{(1)}$	0.05	0.05	$\lambda^{(1)}$
C2	200	$B^{(1)}$	$\Phi^{(1)}$	0.05	0.05	$\lambda^{(2)}$
C3	200	$B^{(1)}$	$\Phi^{(1)}$	0.10	0.10	$\lambda^{(1)}$
C4	200	$B^{(1)}$	$\Phi^{(1)}$	0.10	0.10	$\lambda^{(2)}$
C5	200	$B^{(1)}$	$\Phi^{(2)}$	0.05	0.05	$\lambda^{(1)}$
C6	200	$B^{(1)}$	$\Phi^{(2)}$	0.05	0.05	$\lambda^{(2)}$
C7	200	$B^{(1)}$	$\Phi^{(2)}$	0.10	0.10	$\lambda^{(1)}$
C8	200	$B^{(1)}$	$\Phi^{(2)}$	0.10	0.10	$\lambda^{(2)}$
C9	200	$B^{(1)}$	$\Phi^{(3)}$	0.05	0.05	$\lambda^{(1)}$
C10	200	$B^{(1)}$	$\Phi^{(3)}$	0.05	0.05	$\lambda^{(2)}$
C11	200	$B^{(1)}$	$\Phi^{(3)}$	0.10	0.10	$\lambda^{(1)}$
C12	200	$B^{(1)}$	$\Phi^{(3)}$	0.10	0.10	$\lambda^{(2)}$
C13	200	$B^{(2)}$	$\Phi^{(1)}$	0.05	0.05	$\lambda^{(1)}$
C14	200	$B^{(2)}$	$\Phi^{(1)}$	0.05	0.05	$\lambda^{(2)}$
C15	200	$B^{(2)}$	$\Phi^{(1)}$	0.10	0.10	$\lambda^{(1)}$
C16	200	$B^{(2)}$	$\Phi^{(1)}$	0.10	0.10	$\lambda^{(2)}$
C17	200	$B^{(2)}$	$\Phi^{(2)}$	0.05	0.05	$\lambda^{(1)}$
C18	200	$B^{(2)}$	$\Phi^{(2)}$	0.05	0.05	$\lambda^{(2)}$
C19	200	$B^{(2)}$	$\Phi^{(2)}$	0.10	0.10	$\lambda^{(1)}$
C20	200	$B^{(2)}$	$\Phi^{(2)}$	0.10	0.10	$\lambda^{(2)}$
C21	200	$B^{(2)}$	$\Phi^{(3)}$	0.05	0.05	$\lambda^{(1)}$
C22	200	$B^{(2)}$	$\Phi^{(3)}$	0.05	0.05	$\lambda^{(2)}$
C23	200	$B^{(2)}$	$\Phi^{(3)}$	0.10	0.10	$\lambda^{(1)}$
C24	200	$B^{(2)}$	$\Phi^{(3)}$	0.10	0.10	$\lambda^{(2)}$
C25	200	$B^{(2)}$	$\Phi^{(1)}$	0.05	0.10	$\lambda^{(1)}$
C26	200	$B^{(2)}$	$\Phi^{(1)}$	0.05	0.10	$\lambda^{(2)}$
C27	200	$B^{(2)}$	$\Phi^{(1)}$	0.10	0.05	$\lambda^{(1)}$
C28	200	$B^{(2)}$	$\Phi^{(1)}$	0.10	0.05	$\lambda^{(2)}$

Table A.2: Simulation Result of the SEM approach (A1, B1, C1)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A1)	SEM			size:2000			**110 cases converge**			
mean	0.6523	0.7008	0.6011	0.7460	0.7015	0.8011	0.8003	0.8590	0.9034	0.2008
bias	-0.0023	-0.0083	-0.0011	0.0039	-0.0015	-0.0011	-0.0003	-0.0090	-0.0034	-0.0008
RMSE	0.0500	0.0408	0.0117	0.0451	0.0103	0.0508	0.0116	0.0671	0.0257	0.0104
SD ratio	0.9752	1.0482	1.1435	1.0485	0.9662	1.0828	1.0506	1.0077	0.9960	0.9273
(B1)	SEm			size:500			**110 cases converge**			
mean	0.6508	0.7033	0.5998	0.7534	0.7001	0.7949	0.8030	0.8538	0.8985	0.2021
bias	-0.0008	-0.0033	0.0002	-0.0034	-0.0001	0.0051	-0.0030	-0.0038	0.0015	-0.0021
RMSE	0.1051	0.0636	0.0238	0.0803	0.0158	0.1004	0.0163	0.1132	0.0675	0.0333
SD ratio	1.0803	1.0190	1.0743	1.0313	0.8843	0.9899	0.8950	0.9965	0.9934	1.0951
(C1)	SEM			size:200			**110 cases converge**			
mean	0.6363	0.6858	0.6018	0.7479	0.6974	0.7871	0.7991	0.8426	0.8861	0.2009
bias	0.0137	0.0142	-0.0018	0.0021	0.0026	0.0129	0.0009	0.0074	0.0139	-0.0009
RMSE	0.1849	0.1363	0.0355	0.1535	0.0340	0.1707	0.0393	0.2489	0.0855	0.0401
SD ratio	1.1268	1.1121	1.1102	1.1357	1.0170	1.1496	1.1360	1.1157	1.0716	1.1713

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	3.00	0.50	5.00	1.00	3.00	5.00
(A1)	SEM			size:2000			**110 cases converge**		
mean	0.9507	0.3011	0.4017	3.0001	0.4999	4.9412	0.9948	3.0129	4.9958
bias	-0.0007	-0.0011	-0.0017	-0.0001	0.0001	0.0588	0.0051	-0.0129	0.0042
RMSE	0.0290	0.0116	0.0110	0.1270	0.1475	0.3891	0.0712	0.0725	0.1026
SD ratio	1.1032	0.9980	1.0110	0.9934	0.9616	1.0852	0.9752	0.9116	0.9557
(B1)	SEM			size:500			**110 cases converge**		
mean	0.9492	0.3028	0.4019	2.9452	0.4428	4.9648	0.9858	3.0308	5.0365
bias	0.0008	-0.0028	-0.0019	0.0548	0.0572	0.0352	0.0142	-0.0308	-0.0365
RMSE	0.0429	0.0258	0.0273	0.2714	0.3487	0.7763	0.1676	0.1825	0.2466
SD ratio	1.0380	1.1369	1.0915	1.0395	1.1349	1.1063	1.1467	1.1564	1.1395
(C1)	SEM			size:200			**110 cases converge**		
mean	0.9567	0.2962	0.4004	3.0000	0.5842	5.2035	0.9919	3.0270	4.9976
bias	-0.0067	0.0038	-0.0004	0.0000	-0.0842	-0.2035	0.0081	-0.0270	0.0025
RMSE	0.0848	0.0448	0.0434	0.4644	0.5361	1.5055	0.2532	0.2296	0.3660
SD ratio	1.0497	1.2261	1.2595	1.1226	1.0641	1.2582	1.1117	0.9199	1.0019

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A1)	SEM			size:2000			**110 cases converge**		
mean	0.5000	0.5002	0.4996	0.4992	0.5115	0.4987	0.4991	0.5003	*fixed*
bias	0.0000	-0.0002	0.0004	0.0008	-0.0115	0.0013	0.0009	-0.0003	
RMSE	0.0297	0.0175	0.0207	0.0222	0.1657	0.0226	0.0222	0.0212	
SD ratio	1.0518	0.9327	1.0388	1.0324	1.0101	1.0004	1.0191	0.9281	
(B1)	SEM			size:500			**110 cases converge**		
mean	0.5014	0.4944	0.4987	0.4922	0.4925	0.5049	0.4980	0.4963	*fixed*
bias	-0.0014	0.0056	0.0013	0.0078	0.0075	-0.0050	0.0021	0.0037	
RMSE	0.0588	0.0413	0.0399	0.0450	0.3666	0.0470	0.0491	0.0460	
SD ratio	1.0445	1.0961	1.0014	1.0361	1.1273	1.0364	1.1324	1.0058	
(C1)	SEM			size:200			**110 cases converge**		
mean	0.4963	0.4874	0.4912	0.4974	0.3329	0.5035	0.4925	0.4989	*fixed*
bias	0.0037	0.0126	0.0088	0.0026	0.1671	-0.0035	0.0075	0.0011	
RMSE	0.0942	0.0583	0.0659	0.0597	1.0596	0.0708	0.0807	0.0637	
SD ratio	1.0515	0.9752	1.0478	0.8769	1.7396	1.0052	1.1578	0.8743	

Table A.3: Simulation Result of the Classical approach (A1, B1, C1)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A1)	Classical			size:2000			**109 cases converge**			
mean	0.6502	0.6994	0.5980	0.7421	0.7015	0.7977	0.7977	0.8063	0.9021	0.1965
bias	-0.0002	0.0006	0.0020	0.0079	-0.0015	0.0023	0.0023	0.0437	-0.0021	0.0035
RMSE	0.1135	0.1041	0.0280	0.1071	0.0256	0.1230	0.0290	0.2396	0.0469	0.0154
SD ratio	0.9852	1.0370	1.1908	0.9851	1.0982	1.0283	1.1787	0.8944	0.9505	0.8005
(B1)	Classical			size:500			**78 cases converge**			
mean	0.7043	0.7658	0.5666	0.8222	0.6647	0.8678	0.7701	0.8478	0.9604	0.1605
bias	-0.0543	-0.0658	0.0334	-0.0722	0.0353	-0.0678	0.0299	0.0022	-0.0604	0.0395
RMSE	0.2105	0.1860	0.0829	0.2277	0.1177	0.2122	0.0662	0.2895	0.3723	0.2702
SD ratio	0.9566	0.8926	1.0329	0.9555	1.2268	0.9069	0.9110	0.6967	1.6316	1.8894
(C1)	Classical			size:200			**71 cases converge**			
mean	0.7518	0.8161	0.5459	0.8577	0.6460	0.9163	0.7468	0.9442	0.9511	0.1748
bias	-0.1079	-0.1161	0.0541	-0.1077	0.0540	-0.1163	0.0532	-0.0942	-0.0511	0.0252
RMSE	0.3007	0.2705	0.1327	0.2858	0.1602	0.3039	0.1486	0.3056	0.1455	0.0757
SD ratio	1.0814	1.9394	1.4120	1.9806	1.6678	2.4045	1.9033	1.7218	0.9044	0.4014

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	3.00	0.50	5.00	1.00	3.00	5.00
(A1)	Classical			size:2000			**109 cases converge**		
mean	0.9506	0.2956	0.3966	2.9936	0.5428	5.2731	1.2273	3.0835	5.0999
bias	-0.0006	0.0044	0.0034	0.0064	-0.0429	-0.2731	-0.2273	-0.0835	-0.0999
RMSE	0.0389	0.0262	0.0406	0.2488	0.3953	1.4196	0.6073	0.3003	0.5280
SD ratio	1.0838	0.9020	0.9226	0.9870	0.9332	0.9936	24.7885	38.3155	77.7861
(B1)	Classical			size:500			**78 cases converge**		
mean	0.9610	0.2971	0.4100	2.8120	0.3383	5.0326	2.0046	3.0481	4.9250
bias	-0.0110	0.0029	-0.0100	0.1880	0.1617	-0.0326	-1.0046	-0.0481	0.0750
RMSE	0.0980	0.0612	0.0578	0.5653	0.6522	1.7311	1.3599	0.5988	0.8417
SD ratio	0.9984	0.8378	0.7946	1.0798	0.8681	0.7909	13.4190	24.2079	35.0323
(C1)	Classical			size:200			**71 cases converge**		
mean	0.9854	0.2881	0.4286	2.7400	0.3161	4.6840	1.9721	2.7119	4.5450
bias	-0.0354	0.0119	-0.0286	0.2600	0.1839	0.3160	-0.9721	0.2881	0.4550
RMSE	0.2206	0.2018	0.0790	0.7512	0.7535	1.8266	1.7559	0.7752	0.9636
SD ratio	1.4326	2.2887	1.0279	0.9518	0.8161	0.8857	11.5776	13.6548	17.7042

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A1)	Classical			size:2000			**109 cases converge**		
mean	0.4990	0.4991	0.4988	0.4988	0.7355	0.4976	0.4976	0.5002	*fixed*
bias	0.0010	0.0009	0.0012	0.0012	-0.2355	0.0024	0.0024	-0.0002	
RMSE	0.0348	0.0176	0.0204	0.0232	0.5671	0.0262	0.0222	0.0283	
SD ratio	1.0370	0.9114	1.0060	1.0483	0.5121	0.9875	0.9095	0.9325	
(B1)	Classical			size:500			**78 cases converge**		
mean	0.4778	0.4846	0.4947	0.4913	0.8810	0.4932	0.4947	0.4826	*fixed*
bias	0.0222	0.0154	0.0053	0.0087	-0.3810	0.0068	0.0053	0.0174	
RMSE	0.0817	0.0471	0.0436	0.0464	0.7521	0.0699	0.0485	0.0606	
SD ratio	1.0582	1.1326	1.0587	1.0371	0.4644	1.0886	1.0269	1.0243	
(C1)	Classical			size:200			**71 cases converge**		
mean	0.4563	0.4661	0.4847	0.4837	1.0306	0.4653	0.4834	0.4747	*fixed*
bias	0.0437	0.0339	0.0153	0.0163	-0.5306	0.0347	0.0166	0.0253	
RMSE	0.1557	0.0756	0.0695	0.0645	0.8278	0.1020	0.0982	0.0827	
SD ratio	1.0578	1.0772	0.9977	0.8748	0.4578	0.9639	1.2422	0.8899	

Table A.4: Simulation Result of the SEM approach (A2, B2, C2)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A2)	SEM			size: 2000				**110 cases converge**		
mean	0.6424	0.6978	0.5991	0.7455	0.6987	0.7927	0.7994	0.8473	0.8993	0.2002
bias	0.0076	0.0022	0.0009	0.0045	0.0013	0.0073	0.0006	0.0027	0.0007	-0.0002
RMSE	0.0614	0.0460	0.0114	0.0485	0.0104	0.0562	0.0126	0.0660	0.0169	0.0154
SD ratio	1.1039	1.0581	1.0298	1.0129	0.9149	1.0647	1.0757	1.0574	0.9727	1.0865
(B2)	SEM			size: 500				**110 cases converge**		
mean	0.6425	0.7012	0.5965	0.7519	0.6939	0.7997	0.7952	0.8479	0.8921	0.2017
bias	0.0075	-0.0012	0.0035	-0.0019	0.0061	0.0003	0.0048	0.0021	0.0079	-0.0017
RMSE	0.1316	0.1022	0.0254	0.1198	0.0293	0.1347	0.0289	0.1163	0.0320	0.0340
SD ratio	1.1743	1.1673	1.0988	1.2389	1.2056	1.2701	1.1574	0.9354	0.9008	1.1842
(C2)	SEM			size: 200				**109 cases converge**		
mean	0.6591	0.6982	0.6016	0.7582	0.6947	0.7844	0.8033	0.7873	0.8960	0.1967
bias	-0.0092	0.0018	-0.0016	-0.0082	0.0053	0.0156	-0.0033	0.0627	0.0040	0.0033
RMSE	0.1886	0.1317	0.0338	0.1635	0.0387	0.1809	0.0434	0.2573	0.0540	0.0471
SD ratio	1.0600	0.9519	0.9431	1.0725	1.0272	1.0843	1.1306	1.1679	1.0004	1.0716

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	3.00	0.50	5.00	1.00	3.00	0.00
(A2)	SEM			size:2000				**110 cases converge**	
mean	0.9478	0.2993	0.3993	2.9997	0.5194	5.0523	1.0003	3.0104	-0.0020
bias	0.0022	0.0007	0.0007	0.0003	-0.0195	-0.0523	-0.0003	-0.0104	0.0020
RMSE	0.0162	0.0176	0.0224	0.1231	0.1518	0.4584	0.0454	0.0905	0.1030
SD ratio	0.9477	1.0113	1.0520	0.9596	0.9739	1.1105	1.0861	1.1646	1.0007
(B2)	SEM			size:500				**110 cases converge**	
mean	0.9478	0.2988	0.4001	2.9941	0.5262	5.0217	1.0170	2.9933	-0.0098
bias	0.0022	0.0012	-0.0001	0.0059	-0.0262	-0.0217	-0.0170	0.0067	0.0098
RMSE	0.0312	0.0387	0.0449	0.2679	0.3186	0.7129	0.0912	0.1805	0.2252
SD ratio	0.9246	1.1066	1.0519	1.0176	1.0335	0.8630	1.0432	1.1217	1.0779
(C2)	SEM			size:200				**109 cases converge**	
mean	0.9523	0.2882	0.3854	3.0107	0.5723	5.7493	1.0113	2.9904	0.0234
bias	-0.0023	0.0118	0.0146	-0.0107	-0.0723	-0.7493	-0.0113	0.0096	-0.0234
RMSE	0.0612	0.0624	0.0745	0.4532	0.4813	2.1715	0.1429	0.1805	0.2252
SD ratio	1.1546	1.1621	1.1189	1.0654	0.9437	1.3582	1.0569	1.0951	1.0158

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A2)	SEM			size:2000				**110 cases converge**	
mean	0.5016	0.5031	0.4966	0.5016	0.4650	0.5002	0.5013	0.5024	*fixed*
bias	-0.0016	-0.0031	0.0034	-0.0016	0.0350	-0.0002	-0.0013	-0.0024	
RMSE	0.0312	0.0174	0.0184	0.0236	0.2505	0.0233	0.0198	0.0266	
SD ratio	1.0770	0.9093	0.9111	1.0906	1.0299	1.0623	0.9484	1.0458	
(B2)	SEM			size:500				**110 cases converge**	
mean	0.4924	0.4939	0.4977	0.5008	0.4264	0.4992	0.4962	0.5031	*fixed*
bias	0.0076	0.0061	0.0023	-0.0008	0.0736	0.0008	0.0038	-0.0031	
RMSE	0.0601	0.0353	0.0422	0.0390	0.4859	0.0475	0.0398	0.0456	
SD ratio	1.0313	0.9404	1.0609	0.9199	0.9970	1.0882	0.8939	0.9311	
(C2)	SEM			size:200				**109 cases converge**	
mean	0.5077	0.5054	0.4950	0.4931	-0.0302	0.4902	0.4947	0.5068	*fixed*
bias	-0.0077	-0.0054	0.0050	0.0069	0.5302	0.0098	0.0053	-0.0068	
RMSE	0.0880	0.0593	0.0654	0.0753	1.8075	0.0772	0.0692	0.0911	
SD ratio	0.9426	0.9815	1.0390	1.0997	1.7656	1.1356	1.0357	1.1344	

Table A.5: Simulation Result of the Classical approach (A2, B2, C2)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A2)	Classical			size:2000			**107 cases converge**			
mean	0.6640	0.7189	0.5927	0.7676	0.6924	0.8155	0.7936	0.8610	0.9109	0.1963
bias	-0.0140	-0.0189	0.0073	-0.0176	0.0076	-0.0155	0.0064	-0.0110	-0.0109	0.0037
RMSE	0.1081	0.0928	0.0240	0.0984	0.0231	0.1090	0.0250	0.1925	0.0446	0.0193
SD ratio	1.0028	0.9969	0.9613	0.9675	0.9161	0.9860	0.9933	1.0019	0.9296	1.0944
(B2)	Classical			size:500			**89 cases converge**			
mean	0.7004	0.7580	0.5667	0.8163	0.6598	0.8687	0.7704	0.8732	0.9696	0.1446
bias	-0.0504	-0.0580	0.0333	-0.0663	0.0402	-0.0687	0.0296	-0.0232	-0.0696	0.0554
RMSE	0.2335	0.2032	0.0964	0.2429	0.1105	0.2486	0.0863	0.2941	0.4371	0.3719
SD ratio	1.0903	0.9285	0.9724	1.0151	1.0409	1.0266	0.9968	0.7491	1.3132	1.4797
(C2)	Classical			size:200			**61 cases converge**			
mean	0.7742	0.8631	0.4926	0.9108	0.6110	0.9178	0.7698	0.9264	0.9588	0.1616
bias	-0.1242	-0.1631	0.1074	-0.1608	0.0890	-0.1178	0.0302	-0.0764	-0.0588	0.0384
RMSE	0.3069	0.4931	0.4501	0.3733	0.2614	0.3441	0.2735	0.3294	0.2259	0.1436
SD ratio	0.9507	0.6781	0.6555	0.6428	0.5557	0.6101	0.6594	0.7622	0.5218	1.1952

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	3.00	0.50	5.00	1.00	3.00	0.00
(A2)	Classical			size:2000			**107 cases converge**		
mean	0.9493	0.3017	0.4053	2.9486	0.4641	4.9940	1.0074	2.9667	-0.0484
bias	0.0007	-0.0017	-0.0053	0.0514	0.0359	0.0060	-0.0074	0.0333	0.0484
RMSE	0.0318	0.0250	0.0364	0.2400	0.3274	1.1626	0.2383	0.2095	0.2517
SD ratio	0.9112	1.0149	0.9733	0.9691	0.9141	1.0984	22.0544	57.3101	84.8336
(B2)	Classical			size:500			**89 cases converge**		
mean	0.9646	0.2934	0.4125	2.8630	0.3928	4.9269	0.8687	2.8008	-0.1258
bias	-0.0146	0.0066	-0.0125	0.1370	0.1072	0.0731	0.1313	0.1992	0.1258
RMSE	0.1110	0.0836	0.0662	0.4921	0.5935	1.7378	0.4307	0.4245	0.4139
SD ratio	0.9279	0.9018	0.9188	0.9500	0.8406	0.8687	13.1623	28.8785	34.3636
(C2)	Classical			size:200			**61 cases converge**		
mean	1.0188	0.2483	0.4174	2.7263	0.1735	4.8459	0.9997	2.7468	-0.2217
bias	-0.0688	0.0517	-0.0174	0.2737	0.3265	0.1541	0.0003	0.2532	0.2217
RMSE	0.2595	0.1912	0.0804	0.8117	0.8351	1.9530	0.6142	0.6146	0.5522
SD ratio	0.5831	0.5446	0.9314	1.0138	0.8992	0.8528	10.0407	20.0289	19.6532

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A2)	Classical			size:2000			**107 cases converge**		
mean	0.4956	0.5014	0.4959	0.5019	0.7022	0.4948	0.5007	0.4985	*fixed*
bias	0.0044	-0.0014	0.0041	-0.0019	-0.2022	0.0052	-0.0007	0.0015	
RMSE	0.0393	0.0173	0.0191	0.0236	0.4776	0.0297	0.0227	0.0311	
SD ratio	1.1322	0.8882	0.9239	1.0590	0.6447	1.0843	0.9469	1.0513	
(B2)	Classical			size:500			**89 cases converge**		
mean	0.4653	0.4918	0.4964	0.5002	0.8982	0.4769	0.4931	0.4927	*fixed*
bias	0.0347	0.0082	0.0036	-0.0002	-0.3982	0.0231	0.0069	0.0073	
RMSE	0.1208	0.0388	0.0457	0.0373	0.7297	0.0848	0.0470	0.0579	
SD ratio	1.3533	0.9806	1.1003	0.8309	0.4616	1.1432	0.9786	0.9719	
(C2)	Classical			size:200			**61 cases converge**		
mean	0.4671	0.4985	0.4902	0.4819	1.0556	0.4687	0.4759	0.4730	*fixed*
bias	0.0329	0.0015	0.0098	0.0181	-0.5556	0.0313	0.0241	0.0270	
RMSE	0.1700	0.0705	0.0831	0.0970	0.9320	0.0963	0.1235	0.0765	
SD ratio	1.1616	1.0590	1.2085	1.3048	0.5287	0.9734	0.7896	0.8066	

Table A.6: Simulation Result of the SEM approach (A3, B3, C3)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A3)	SEM			size:2000			**110 cases converge**			
mean	0.6574	0.7087	0.5978	0.7565	0.7001	0.8068	0.7997	0.8413	0.9028	0.1998
bias	-0.0074	-0.0087	0.0022	-0.0065	-0.0001	-0.0068	0.0003	0.0087	-0.0028	0.0002
RMSE	0.0501	0.0386	0.0101	0.0402	0.0103	0.0433	0.0105	0.0707	0.0254	0.0112
SD ratio	0.9721	0.9689	0.9572	0.9274	0.9655	0.9136	0.9354	1.0671	0.9964	1.0198
(B3)	SEM			size:500			**110 cases converge**			
mean	0.6566	0.7078	0.5998	0.7609	0.6992	0.7963	0.8041	0.8400	0.9002	0.2016
bias	-0.0066	-0.0078	0.0002	-0.0109	0.0008	0.0037	-0.0041	0.0100	-0.0002	-0.0016
RMSE	0.1039	0.0809	0.0207	0.0947	0.0239	0.0978	0.0217	0.1298	0.0532	0.0242
SD ratio	1.0113	1.0346	1.0145	1.0976	1.1259	1.0417	0.9695	0.9838	1.0543	1.1149
(C3)	SEM			size:200			**110 cases converge**			
mean	0.6464	0.6877	0.6015	0.7367	0.7064	0.7779	0.8069	0.8536	0.8926	0.2015
bias	0.0036	0.0123	-0.0015	0.0133	-0.0064	0.0221	-0.0069	-0.0036	0.0074	-0.0015
RMSE	0.1727	0.1393	0.0396	0.1461	0.0366	0.1621	0.0380	0.2181	0.0861	0.0410
SD ratio	1.0496	1.1324	1.2332	1.0709	1.0941	1.0776	1.0914	1.0374	1.0972	1.1409

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	3.00	0.50	5.00	1.00	3.00	5.00
(A3)	SEM			size:2000			**110 cases converge**		
mean	0.9506	0.2995	0.3996	2.9890	0.4941	5.0379	1.0003	2.9924	5.0026
bias	-0.0006	0.0005	0.0004	0.0110	0.0059	-0.0379	-0.0003	0.0076	-0.0026
RMSE	0.0256	0.0119	0.0114	0.1283	0.1598	0.3814	0.0749	0.0914	0.1195
SD ratio	0.9790	1.0416	1.0626	1.0053	1.0437	1.0696	1.0471	1.1707	1.1254
(B3)	SEM			size:500			**110 cases converge**		
mean	0.9398	0.3035	0.4024	2.9806	0.5277	5.1415	0.9796	3.0202	5.0247
bias	0.0102	-0.0035	-0.0024	0.0194	-0.0278	-0.1415	0.0204	-0.0202	-0.0247
RMSE	0.0596	0.0259	0.0237	0.2818	0.3558	0.7686	0.1582	0.1657	0.2290
SD ratio	1.1317	1.1475	1.1118	1.0957	1.1536	1.0584	1.0949	1.0595	1.0695
(C3)	SEM			size:200			**110 cases converge**		
mean	0.9566	0.2955	0.4001	2.9644	0.4314	4.9086	0.9922	3.0136	4.9806
bias	-0.0066	0.0045	-0.0001	0.0356	0.0686	0.0914	0.0078	-0.0136	0.0194
RMSE	0.0995	0.0490	0.0434	0.4688	0.5132	1.3106	0.2988	0.2552	0.3986
SD ratio	1.2322	1.3032	1.2394	1.1302	1.0642	1.1252	1.2604	1.0108	1.1136

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A3)	SEM			size:2000			**110 cases converge**		
mean	0.4956	0.5005	0.4992	0.5017	0.4855	0.4985	0.4996	0.4990	*fixed*
bias	0.0044	-0.0005	0.0008	-0.0017	0.0145	0.0015	0.0004	0.0010	
RMSE	0.0312	0.0185	0.0188	0.0190	0.1743	0.0187	0.0205	0.0230	
SD ratio	1.0918	0.9798	0.9424	0.8751	1.0478	0.8291	0.9468	1.0071	
(B3)	SEM			size:500			**110 cases converge**		
mean	0.4931	0.5023	0.5017	0.5015	0.4845	0.4961	0.5011	0.5002	*fixed*
bias	0.0069	-0.0024	-0.0017	-0.0015	0.0155	0.0039	-0.0011	-0.0002	
RMSE	0.0573	0.0369	0.0406	0.0422	0.3532	0.0416	0.0421	0.0441	
SD ratio	1.0108	0.9727	1.0119	0.9724	1.0585	0.9254	0.9730	0.9584	
(C3)	SEM			size:200			**110 cases converge**		
mean	0.5054	0.4998	0.4907	0.4943	0.4504	0.4981	0.4862	0.4885	*fixed*
bias	-0.0054	0.0002	0.0093	0.0057	0.0496	0.0019	0.0138	0.0115	
RMSE	0.0905	0.0593	0.0697	0.0690	0.0843	0.0742	0.0781	0.0716	
SD ratio	1.0197	0.9928	1.1067	1.0113	1.1955	1.0618	1.1201	0.9824	

Table A.7: Simulation Result of the Classical approach (A3, B3, C3)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A3)	Classical			size:2000			**107 cases converge**			
mean	0.6697	0.7188	0.5939	0.7673	0.6953	0.8168	0.7950	0.8116	0.9059	0.1972
bias	-0.0197	-0.0188	0.0061	-0.0174	0.0047	-0.0168	0.0050	0.0384	-0.0059	0.0028
RMSE	0.1089	0.0931	0.0217	0.0997	0.0232	0.1080	0.0239	0.2144	0.0475	0.0155
SD ratio	0.9823	0.9731	0.8910	0.9496	0.9643	0.9460	0.9744	0.9317	1.0064	0.8656
(B3)	Classical			size:500			**86 cases converge**			
mean	0.7095	0.7666	0.5753	0.8223	0.6683	0.8639	0.7784	0.8579	0.9248	0.1928
bias	-0.0595	-0.0667	0.0247	-0.0723	0.0317	-0.0639	0.0216	-0.0079	-0.0248	0.0072
RMSE	0.1964	0.1690	0.0685	0.1846	0.0732	0.2086	0.0739	0.2583	0.1032	0.0467
SD ratio	0.9134	0.8941	1.1245	0.8891	1.1376	0.9497	1.1982	0.7745	0.9805	0.9957
(C3)	Classical			size:200			**59 cases converge**			
mean	0.7105	0.8016	0.5412	0.8466	0.6469	0.8825	0.7640	0.8964	0.9842	0.1285
bias	-0.0605	-0.1016	0.0588	-0.0966	0.0531	-0.0825	0.0360	-0.0464	-0.0842	0.0715
RMSE	0.3217	0.2741	0.1221	0.3042	0.1282	0.3061	0.1218	0.3183	0.4772	0.4687
SD ratio	1.0931	0.9809	0.8999	1.0258	0.9896	0.9699	0.9619	0.7231	0.6828	0.7212

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	3.00	0.50	5.00	1.00	3.00	5.00
(A3)	Classical			size:2000			**107 cases converge**		
mean	0.9525	0.2980	0.3982	2.9636	0.5022	5.2407	1.1783	3.0484	5.0779
bias	-0.0025	0.0020	0.0018	0.0364	-0.0022	-0.2407	-0.1783	-0.0484	-0.0779
RMSE	0.0342	0.0240	0.0370	0.2418	0.3617	1.3733	0.6143	0.2664	0.4727
SD ratio	0.9816	0.9043	0.9350	0.9727	0.9321	1.0450	23.7255	34.9581	70.9263
(B3)	Classical			size:500			**86 cases converge**		
mean	0.9329	0.3113	0.4169	2.8671	0.4287	5.0554	1.5932	2.9348	4.8570
bias	0.0171	-0.0113	-0.0169	0.1329	0.0713	-0.0554	-0.5932	0.0652	0.1430
RMSE	0.0697	0.0431	0.0623	0.5061	0.5731	1.5943	1.4437	0.5210	0.7321
SD ratio	0.9680	0.8513	0.9547	0.9754	0.8771	0.8406	19.5825	22.0768	31.2391
(C3)	Classical			size:200			**59 cases converge**		
mean	0.9663	0.2998	0.4265	2.8236	0.2505	4.6859	2.0701	2.8488	4.5511
bias	-0.0163	0.0002	-0.0265	0.1764	0.2495	0.3141	-1.0701	0.1512	0.4489
RMSE	0.1528	0.0761	0.0765	0.8294	0.8031	2.0027	1.8051	0.9095	1.0455
SD ratio	1.1017	0.7971	0.8527	1.1162	0.9041	1.0055	12.6030	16.8134	18.7565

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A3)	Classical			size:2000			**107 cases converge**		
mean	0.4925	0.4995	0.4991	0.5019	0.7064	0.4964	0.4976	0.4981	*fixed*
bias	0.0075	0.0005	0.0009	-0.0019	-0.2065	0.0036	0.0024	0.0019	
RMSE	0.0379	0.0191	0.0188	0.0204	0.6057	0.0224	0.0226	0.0285	
SD ratio	1.0972	0.9945	0.9288	0.9179	0.6575	0.8411	0.9315	0.9580	
(B3)	Classical			size:500			**86 cases converge**		
mean	0.4606	0.4993	0.5011	0.5007	0.8675	0.4835	0.5043	0.4860	*fixed*
bias	0.0394	0.0007	-0.0011	-0.0007	-0.3675	0.0165	-0.0043	0.0140	
RMSE	0.1315	0.0366	0.0382	0.0428	0.6119	0.0773	0.0475	0.0524	
SD ratio	1.3471	0.9282	0.9201	0.9519	0.4097	1.1693	1.0216	0.9052	
(C3)	Classical			size:200			**59 cases converge**		
mean	0.4512	0.4809	0.4753	0.4755	0.9886	0.4908	0.4766	0.4642	*fixed*
bias	0.0488	0.0191	0.0247	0.0245	-0.4886	0.0092	0.0234	0.0358	
RMSE	0.1729	0.0727	0.0799	0.0807	0.8190	0.1263	0.0855	0.0809	
SD ratio	1.0144	1.0116	1.1522	1.0654	0.5844	0.8438	1.0108	0.8576	

Table A.8: Simulation Result of the SEM approach (A4, B4, C4)

Design	Parameters b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A4)	SEM			size:2000			**110 cases converge**			
mean	0.6472	0.6997	0.5984	0.7502	0.6990	0.8000	0.7993	0.8468	0.8996	0.1988
bias	0.0028	0.0003	0.0016	-0.0002	0.0010	0.0000	0.0007	0.0032	0.0004	0.0012
RMSE	0.0568	0.0398	0.0103	0.0465	0.0104	0.0520	0.0115	0.0527	0.0172	0.0145
SD ratio	1.0313	0.9200	0.9318	0.9741	0.9104	0.9956	0.9759	0.8494	0.9922	1.0236
(B4)	SEM			size:500			**110 cases converge**			
mean	0.6665	0.7146	0.5966	0.7755	0.6958	0.8133	0.7996	0.8294	0.8931	0.2033
bias	-0.0165	-0.0146	0.0034	-0.0255	0.0042	-0.0133	0.0005	0.0206	0.0069	-0.0033
RMSE	0.1220	0.0928	0.0240	0.1056	0.0257	0.1117	0.0222	0.1399	0.0386	0.0311
SD ratio	1.0716	1.0324	1.0274	1.0437	1.0594	1.0340	0.9068	1.0825	1.0933	1.0675
(C4)	SEM			size:200			**107 cases converge**			
mean	0.6663	0.7112	0.5936	0.7718	0.6885	0.8093	0.7954	0.8778	0.8886	0.2115
bias	-0.0163	-0.0112	0.0064	-0.0218	0.0115	-0.0093	0.0046	-0.0278	0.0114	-0.0115
RMSE	0.2325	0.1650	0.0228	0.1704	0.0318	0.1722	0.0355	0.1407	0.0597	0.0617
SD ratio	1.1938	1.1347	1.0419	1.1825	1.1536	1.1063	1.0186	1.1420	0.9654	1.1376

Design	Parameters b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	3.00	0.50	5.00	1.00	3.00	0.00
(A4)	SEM			size:2000			**110 cases converge**		
mean	0.9489	0.3002	0.3990	2.9963	0.5135	5.0432	1.0030	3.0019	0.0028
bias	0.0011	-0.0002	0.0010	0.0037	-0.0135	-0.0432	-0.0030	-0.0019	-0.0028
RMSE	0.0179	0.0169	0.0204	0.1189	0.1521	0.3847	0.0387	0.0825	0.1008
SD ratio	1.0566	0.9727	0.9615	0.9286	0.9997	0.9685	0.9203	1.0576	0.9827
(B4)	SEM			size:500			**110 cases converge**		
mean	0.9464	0.3029	0.3999	2.9944	0.5520	5.0809	1.0096	2.9711	0.0057
bias	0.0036	-0.0029	0.0001	0.0056	-0.0520	-0.0809	-0.0096	0.0289	-0.0057
RMSE	0.0376	0.0388	0.0455	0.2170	0.3277	0.8655	0.0979	0.1854	0.2286
SD ratio	1.1080	1.0977	1.0678	0.8156	1.0344	1.0008	1.1138	1.1139	1.0527
(C4)	SEM			size:200			**107 cases converge**		
mean	0.9455	0.3086	0.4166	2.8312	0.4743	5.0816	1.0469	2.9319	-0.0893
bias	0.0045	-0.0086	-0.0166	0.1688	0.0257	-0.0816	-0.0469	0.0681	0.0893
RMSE	0.0358	0.0497	0.0661	0.4888	0.5630	1.5504	0.1825	0.3513	0.4160
SD ratio	1.0050	1.2048	1.1088	1.0070	1.1170	1.1768	1.1612	1.1814	1.1661

Design	Parameters $\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A4)	SEM			size:2000			**110 cases converge**		
mean	0.4972	0.4989	0.5029	0.5020	0.4773	0.4996	0.5027	0.5008	*fixed*
bias	0.0028	0.0011	-0.0029	-0.0020	0.0227	0.0004	-0.0027	-0.0008	
RMSE	0.0313	0.0197	0.0198	0.0224	0.2231	0.0212	0.0212	0.0249	
SD ratio	1.0947	1.0410	0.9912	1.0179	0.9426	0.9396	1.0119	0.9936	
(B4)	SEM			size:500			**110 cases converge**		
mean	0.4947	0.5000	0.5024	0.4952	0.4060	0.5008	0.4987	0.5001	*fixed*
bias	0.0053	0.0000	-0.0024	0.0048	0.0940	-0.0008	0.0013	-0.0001	
RMSE	0.0623	0.0372	0.0435	0.0430	0.6051	0.0448	0.0443	0.0485	
SD ratio	1.0579	1.0150	1.0823	0.9884	1.1275	1.0424	1.0503	0.9528	
(C4)	SEM			size:200			**107 cases converge**		
mean	0.4977	0.5017	0.4934	0.4977	0.4541	0.5013	0.4999	0.4848	*fixed*
bias	0.0023	-0.0017	0.0066	0.0023	0.0459	-0.0013	0.0001	0.0153	
RMSE	0.1043	0.0534	0.0667	0.0705	0.9073	0.0807	0.0686	0.0853	
SD ratio	1.1022	0.8881	1.0532	1.0292	1.1458	1.1866	1.0330	1.0620	

Table A.9: Simulation Result of the Classical approach (A4, B4, C4)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A4)	Classical			size:2000			**105 cases converge**			
mean	0.6532	0.7041	0.5953	0.7561	0.6932	0.8054	0.7946	0.8176	0.9063	0.1942
bias	-0.0032	-0.0041	0.0047	-0.0061	0.0068	-0.0054	0.0054	0.0324	-0.0063	0.0058
RMSE	0.1197	0.0973	0.0236	0.1102	0.0240	0.1202	0.0246	0.2018	0.0477	0.0177
SD ratio	1.0980	1.0430	1.0165	1.0720	0.9966	1.0718	1.0232	0.8599	0.9878	0.9378
(B4)	Classical			size:500			**89 cases converge**			
mean	0.7041	0.7539	0.5684	0.8249	0.6674	0.8681	0.7739	0.8243	0.9191	0.1870
bias	-0.0541	-0.0539	0.0316	-0.0749	0.0326	-0.0681	0.0261	0.0257	-0.0191	0.0130
RMSE	0.2436	0.2094	0.1115	0.2386	0.1069	0.2459	0.0829	0.3309	0.1027	0.0507
SD ratio	1.1307	1.0486	1.4073	1.0814	1.3635	1.0474	1.1238	0.7292	0.9100	0.8851
(C4)	Classical			size:200			**58 cases converge**			
mean	0.7205	0.8095	0.5497	0.8635	0.6525	0.9026	0.7543	0.9987	0.9813	0.1730
bias	-0.0705	-0.1095	0.0503	-0.1135	0.0475	-0.1026	0.0457	-0.1487	-0.0813	0.0270
RMSE	0.2774	0.2514	0.1113	0.2663	0.1108	0.2697	0.1094	0.3222	0.2751	0.1371
SD ratio	0.8580	0.8620	0.8744	0.8700	0.9679	0.8127	0.9173	0.8706	0.8103	0.7666

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	3.00	0.50	5.00	1.00	3.00	0.00
(A4)	Classical			size:2000			**105 cases converge**		
mean	0.9490	0.2985	0.3972	2.9757	0.5210	5.2545	0.9989	2.9824	0.0048
bias	0.0010	0.0015	0.0028	0.0243	-0.0210	-0.2545	0.0011	0.0176	-0.0048
RMSE	0.0330	0.0267	0.0392	0.2623	0.3517	1.2510	0.2462	0.2093	0.2742
SD ratio	0.9339	1.0022	0.9638	1.0709	0.8992	0.8673	25.9235	61.1591	96.4766
(B4)	Classical			size:500			**89 cases converge**		
mean	0.9569	0.2983	0.4114	2.8853	0.4626	5.1273	0.9280	2.8513	-0.0583
bias	-0.0069	0.0017	-0.0114	0.1147	0.0374	-0.1274	0.0720	0.1487	0.0583
RMSE	0.1069	0.0642	0.0678	0.5546	0.6684	1.9923	0.4113	0.4435	0.4762
SD ratio	1.2137	0.9423	0.9079	1.0808	0.8947	0.9445	13.2725	32.3687	38.6482
(C4)	Classical			size:200			**58 cases converge**		
mean	0.9537	0.3208	0.4508	2.6783	0.2290	4.4688	0.8865	2.7171	-0.3175
bias	-0.0037	-0.0208	-0.0508	0.3217	0.2710	0.5312	0.1135	0.2829	0.3175
RMSE	0.1232	0.0671	0.0890	0.8574	1.0496	1.8144	0.6597	0.4917	0.5496
SD ratio	1.0361	0.8801	0.9687	0.8631	0.7857	0.9519	10.3861	14.5813	17.0466

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A4)	Classical			size:2000			**105 cases converge**		
mean	0.4932	0.4981	0.5020	0.5020	0.7095	0.4953	0.5020	0.5016	*fixed*
bias	0.0068	0.0019	-0.0020	-0.0020	-0.2095	0.0047	-0.0020	-0.0016	
RMSE	0.0360	0.0205	0.0208	0.0229	0.4533	0.0250	0.0255	0.0312	
SD ratio	1.0490	1.0650	1.0188	1.0298	0.4661	0.9198	1.0539	1.0355	
(B4)	Classical			size:500			**89 cases converge**		
mean	0.4747	0.4942	0.4972	0.4943	1.0386	0.4893	0.4965	0.4855	*fixed*
bias	0.0253	0.0058	0.0028	0.0057	-0.5386	0.0107	0.0036	0.0145	
RMSE	0.0920	0.0385	0.0428	0.0465	0.8903	0.0652	0.0526	0.0537	
SD ratio	1.1095	0.9793	1.0283	1.0352	0.4343	1.0985	1.0874	0.8857	
(C4)	Classical			size:200			**58 cases converge**		
mean	0.4577	0.4876	0.4839	0.4951	1.0951	0.4499	0.5017	0.4523	*fixed*
bias	0.0423	0.0125	0.0161	0.0049	-0.5951	0.0501	-0.0017	0.0477	
RMSE	0.1689	0.0626	0.0817	0.0721	0.7644	0.1401	0.0854	0.0895	
SD ratio	1.0959	0.7556	1.1762	0.9781	0.4527	0.6965	1.1375	0.8927	

Table A.10: Simulation Result of the SEM approach (A5, B5, C5)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A5)	SEM			size:2000				**110 cases converge**		
mean	0.6461	0.6980	0.5998	0.7496	0.7003	0.8005	0.7989	0.8473	0.9002	0.2004
bias	0.0039	0.0020	0.0002	0.0004	-0.0003	-0.0005	0.0011	0.0027	-0.0002	-0.0004
RMSE	0.0360	0.0292	0.0192	0.0300	0.0198	0.0340	0.0186	0.0453	0.0281	0.0240
SD ratio	1.0910	0.9939	0.8513	0.9675	0.8939	1.0351	0.8438	1.0728	1.0901	0.8527
(B5)	SEM			size:500				**110 cases converge**		
mean	0.6451	0.6920	0.6004	0.7450	0.7001	0.8003	0.7990	0.8371	0.8919	0.1993
bias	0.0049	0.0080	-0.0004	0.0050	-0.0001	-0.0003	0.0010	0.0129	0.0081	0.0007
RMSE	0.0765	0.0650	0.0428	0.0687	0.0424	0.0689	0.0423	0.0833	0.0497	0.0596
SD ratio	1.1422	1.1020	0.9645	1.0984	0.9473	1.0424	0.9465	0.9528	0.9620	1.0651
(C5)	SEM			size:200				**110 cases converge**		
mean	0.6468	0.7044	0.5789	0.7446	0.6846	0.8045	0.7788	0.8263	0.9169	0.1669
bias	0.0032	-0.0044	0.0211	0.0054	0.0154	-0.0045	0.0212	0.0237	-0.0169	0.0331
RMSE	0.0979	0.1027	0.0839	0.1031	0.0713	0.1270	0.0876	0.1331	0.0988	0.1015
SD ratio	0.9505	1.1036	1.1563	1.0344	0.9937	1.2092	1.1870	1.0108	1.2241	1.1522

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.50	1.00	1.00	3.00	5.00
(A5)	SEM			size:2000				**110 cases converge**	
mean	0.9511	0.3003	0.4008	1.0043	0.4973	0.9898	0.9894	3.0091	5.0094
bias	-0.0011	-0.0003	-0.0008	-0.0043	0.0027	0.0102	0.0106	-0.0091	-0.0094
RMSE	0.0254	0.0227	0.0206	0.0646	0.0741	0.1731	0.1546	0.1060	0.1309
SD ratio	0.9752	0.8433	0.8678	1.0490	0.9189	0.9721	0.8694	0.8652	0.8395
(B5)	SEM			size:500				**110 cases converge**	
mean	0.9447	0.2980	0.3985	1.0078	0.5102	1.0433	0.9733	3.0273	5.0485
bias	0.0053	0.0020	0.0015	-0.0078	-0.0102	-0.0433	0.0268	-0.0273	-0.0485
RMSE	0.0561	0.0598	0.0532	0.1319	0.1635	0.3329	0.4432	0.3041	0.3801
SD ratio	1.0812	1.1053	1.1010	1.0293	0.9889	0.9164	1.1405	1.1104	1.0812
(C5)	SEM			size:200				**110 cases converge**	
mean	0.9581	0.2726	0.3764	1.0484	0.5359	1.1882	1.1029	2.9289	4.9533
bias	-0.0081	0.0274	0.0236	-0.0484	-0.0359	-0.1882	-0.1029	0.0711	0.0467
RMSE	0.0715	0.0905	0.0778	0.2083	0.2343	0.5537	0.6128	0.4426	0.5727
SD ratio	0.8750	1.0873	1.0868	1.0551	0.9748	0.9736	1.1182	1.1365	1.1150

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A5)	SEM			size:2000				**110 cases converge**	
mean	0.5000	0.4984	0.5002	0.4957	0.5020	0.5001	0.4993	0.5027	*fixed*
bias	0.0000	0.0016	-0.0002	0.0043	-0.0020	-0.0001	0.0007	-0.0027	
RMSE	0.0259	0.0189	0.0193	0.0229	0.0788	0.0236	0.0195	0.0230	
SD ratio	0.9868	1.0296	1.0016	1.1028	0.9388	1.1659	0.9723	1.0836	
(B5)	SEM			size:500				**110 cases converge**	
mean	0.4947	0.4937	0.4981	0.4912	0.4589	0.4943	0.5020	0.4964	*fixed*
bias	0.0053	0.0063	0.0019	0.0088	0.0411	0.0057	-0.0020	0.0036	
RMSE	0.0522	0.0398	0.0370	0.0386	0.1693	0.0399	0.0337	0.0434	
SD ratio	0.9964	1.0806	0.9608	0.9270	0.9766	0.9860	0.8362	1.0357	
(C5)	SEM			size:200				**110 cases converge**	
mean	0.4773	0.4940	0.5083	0.4936	0.3670	0.4736	0.4938	0.5071	*fixed*
bias	0.0227	0.0060	-0.0083	0.0064	0.1330	0.0264	0.0062	-0.0071	
RMSE	0.0890	0.0617	0.0573	0.0614	0.3094	0.0645	0.0642	0.0660	
SD ratio	1.0181	1.0681	0.9170	0.9477	1.0347	0.9387	1.0151	0.9913	

Table A.11: Simulation Result of the Classical approach (A5, B5, C5)

Design	Parameters b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A5)	Classical			size:2000				**54 cases converge**		
mean	0.6571	0.9844	0.6181	0.9792	0.6831	1.0490	0.7737	0.9183	1.1203	-0.2442
bias	-0.0071	-0.2844	-0.0181	-0.2292	0.0169	-0.2490	0.0263	-0.0683	-0.2203	0.4442
RMSE	0.0590	0.9712	0.3940	0.8492	0.2091	0.7314	0.1500	0.1124	0.5983	1.2659
SD ratio	1.0163	0.3484	0.3406	0.4855	0.3826	0.5363	0.4148	0.6725	0.3252	0.6017
(B5)	Classical			size:500				**44 cases converge**		
mean	0.6563	1.3645	0.5434	0.9003	0.6445	1.0636	0.7480	0.8810	1.0070	-0.0071
bias	-0.0063	-0.6645	0.0566	-0.1503	0.0555	-0.2636	0.0520	-0.0310	-0.1070	0.2071
RMSE	0.1044	3.2003	0.4065	0.6015	0.1391	0.7128	0.1603	0.1183	0.3169	0.5595
SD ratio	1.0206	0.6735	0.5719	0.6722	0.5827	0.5146	0.5174	0.6569	0.5002	0.4886
(C5)	Classical			size:200				**34 cases converge**		
mean	0.6323	0.8349	0.5577	0.7098	0.7562	0.7946	0.7784	0.8555	0.9757	0.0398
bias	0.0177	-0.1349	0.0423	0.0402	-0.0562	0.0054	0.0216	-0.0054	-0.0757	0.1602
RMSE	0.1192	0.6625	0.3715	0.5438	0.3608	0.3818	0.2103	0.1433	0.5470	0.7165
SD ratio	0.7521	0.7346	0.7055	0.7833	0.8335	0.7028	0.6316	0.6834	0.7525	0.6131

Design	Parameters b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.50	1.00	1.00	3.00	5.00
(A5)	Classical			size:2000				**54 cases converge**	
mean	1.1616	-0.1436	0.4503	1.0097	0.4082	0.6777	3.4907	3.3945	4.2048
bias	-0.2116	0.4436	-0.0503	-0.0097	0.0919	0.3223	-2.4907	-0.3945	0.7952
RMSE	0.7740	1.7314	0.0771	0.1327	0.1609	0.5003	3.5152	1.0353	1.3048
SD ratio	0.3262	0.5198	0.7680	0.9679	0.6351	0.6477	34.4710	29.9679	51.6563
(B5)	Classical			size:500				**44 cases converge**	
mean	1.0233	0.1571	0.4133	1.0001	0.4315	0.8453	3.9478	3.4776	4.3319
bias	-0.0733	0.1429	-0.0133	-0.0001	0.0685	0.1547	-2.9478	-0.4776	0.6681
RMSE	0.5863	1.0755	0.0762	0.2085	0.6043	0.5607	3.9231	1.2396	1.2083
SD ratio	0.6047	0.5990	0.7212	0.7777	0.6963	0.6915	17.3406	15.7251	19.6249
(C5)	Classical			size:200				**34 cases converge**	
mean	0.9854	0.2477	0.4154	1.0539	0.5059	0.9542	4.6756	3.8736	4.6362
bias	-0.0354	0.0523	-0.0154	-0.0539	-0.0059	0.0458	-3.6756	-0.8736	0.3638
RMSE	0.3510	0.6156	0.1464	0.3112	0.2651	0.5696	4.3737	1.6802	1.2853
SD ratio	0.7514	0.7395	1.0910	0.7909	0.6838	0.5976	9.0335	9.4741	10.5301

Design	Parameters $\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A5)	Classical			size:2000				**54 cases converge**	
mean	0.4783	0.4940	0.4989	0.4905	0.6121	0.4935	0.4991	0.4899	*fixed*
bias	0.0217	0.0060	0.0012	0.0095	-0.1121	0.0065	0.0009	0.0101	
RMSE	0.0579	0.0215	0.0231	0.0504	0.1944	0.0434	0.0245	0.0306	
SD ratio	1.0296	1.0057	1.0543	1.4917	0.6038	1.2995	0.9912	1.0746	
(B5)	Classical			size:500				**44 cases converge**	
mean	0.4601	0.4647	0.4807	0.4782	0.5741	0.4855	0.4996	0.4881	*fixed*
bias	0.0399	0.0353	0.0193	0.0218	-0.0741	0.0145	0.0004	0.0119	
RMSE	0.1053	0.0890	0.0565	0.0487	0.1962	0.0829	0.0620	0.0479	
SD ratio	0.7816	1.0659	1.0840	0.2498	0.4851	1.0398	1.0290	0.8575	
(C5)	Classical			size:200				**34 cases converge**	
mean	0.4551	0.4509	0.4826	0.4784	0.5620	0.4597	0.4367	0.4817	*fixed*
bias	0.0449	0.0491	0.0174	0.0216	-0.0620	0.0403	0.0634	0.0183	
RMSE	0.1611	0.1044	0.0714	0.1010	0.2741	0.0965	0.1163	0.0780	
SD ratio	0.9491	1.1091	0.9591	1.0399	0.5342	1.1320	0.8799	0.9371	

Table A.12: Simulation Result of the SEM approach (A6, B6, C6)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A6)	SEM			size:2000			**110 cases converge**			
mean	0.6523	0.6972	0.6013	0.7519	0.6991	0.8022	0.7985	0.8462	0.9007	0.2033
bias	-0.0023	0.0028	-0.0013	-0.0019	0.0009	-0.0022	0.0015	0.0038	-0.0007	-0.0033
RMSE	0.0324	0.0303	0.0125	0.0289	0.0117	0.0414	0.0149	0.0484	0.0180	0.0356
SD ratio	0.9564	0.9561	1.0130	0.8828	0.9677	1.1635	1.1367	0.9671	0.9543	0.9156
(B6)	SEM			size:500			**102 cases converge**			
mean	0.6549	0.7030	0.5958	0.7503	0.6999	0.8106	0.7959	0.8328	0.8960	0.1958
bias	-0.0049	-0.0030	0.0042	-0.0003	0.0001	-0.0106	0.0041	0.0172	0.0040	0.0042
RMSE	0.0646	0.0614	0.0295	0.0714	0.0276	0.0748	0.0279	0.1053	0.0379	0.0844
SD ratio	0.9245	0.9739	1.1345	1.0674	1.0443	1.0361	1.0007	1.0788	0.9658	1.1041
(C6)	SEM			size:200			**84 cases converge**			
mean	0.6298	0.6917	0.6000	0.7418	0.6980	0.7870	0.8010	0.7340	0.9333	0.1299
bias	0.0202	0.0083	0.0000	0.0082	0.0020	0.0130	-0.0010	0.1160	-0.0333	0.0701
RMSE	0.0983	0.0949	0.0464	0.1198	0.0560	0.1066	0.0464	0.2620	0.1415	0.2959
SD ratio	0.9376	0.9937	1.2018	1.1861	1.3881	0.9899	1.1194	1.4614	1.5640	1.7109

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.50	1.00	1.00	3.00	0.00
(A6)	SEM			size:2000			**110 cases converge**		
mean	0.9493	0.2970	0.4043	1.0041	0.5070	1.0337	1.0058	2.9975	-0.0036
bias	0.0007	0.0030	-0.0043	-0.0041	-0.0070	-0.0337	-0.0058	0.0025	0.0036
RMSE	0.0195	0.0400	0.0450	0.0582	0.0714	0.2075	0.0404	0.0488	0.0737
SD ratio	1.0240	0.9834	1.0207	0.9107	0.8076	0.9048	1.0122	0.9299	0.9605
(B6)	SEM			size:500			**102 cases converge**		
mean	0.9454	0.2955	0.3910	1.0038	0.5116	1.1193	1.0252	2.9792	-0.0040
bias	0.0046	0.0045	0.0090	-0.0038	-0.0116	-0.1193	-0.0252	0.0208	0.0040
RMSE	0.0427	0.0938	0.0920	0.1287	0.1726	0.5550	0.1141	0.1202	0.1928
SD ratio	1.1232	1.1464	1.1016	0.9740	0.9864	1.1487	1.2717	1.0259	1.1804
(C6)	SEM			size:200			**84 cases converge**		
mean	0.9673	0.2469	0.3654	1.0567	0.6603	1.6537	1.0073	3.0541	0.1298
bias	-0.0173	0.0531	0.0346	-0.0567	-0.1603	-0.6537	-0.0073	-0.0541	-0.1298
RMSE	0.1079	0.2023	0.1355	0.1952	0.3774	1.4162	0.1530	0.1637	0.3488
SD ratio	1.3887	1.2745	1.0985	0.9564	1.2737	1.2973	1.2654	0.9612	1.3794

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A6)	SEM			size:2000			**110 cases converge**		
mean	0.4999	0.5007	0.4974	0.5041	0.4812	0.4998	0.5009	0.5008	*fixed*
bias	0.0001	-0.0007	0.0026	-0.0041	0.0188	0.0002	-0.0009	-0.0008	
RMSE	0.0298	0.0193	0.0183	0.0206	0.1196	0.0197	0.0198	0.0228	
SD ratio	1.2207	1.0527	0.9450	0.9828	1.0004	0.9755	0.9964	1.0623	
(B6)	SEM			size:500			**102 cases converge**		
mean	0.4936	0.5017	0.4950	0.5033	0.3927	0.5001	0.4977	0.4972	*fixed*
bias	0.0064	-0.0017	0.0050	-0.0033	0.1073	-0.0001	0.0023	0.0028	
RMSE	0.0510	0.0377	0.0403	0.0359	0.3390	0.0433	0.0394	0.0410	
SD ratio	1.0280	1.0276	1.0440	0.8764	1.1984	1.0694	0.9849	0.9694	
(C6)	SEM			size:200			**84 cases converge**		
mean	0.4876	0.4942	0.4877	0.4885	0.0361	0.4856	0.4916	0.5099	*fixed*
bias	0.0124	0.0058	0.0123	0.0115	0.4639	0.0144	0.0084	-0.0099	
RMSE	0.0855	0.0611	0.0652	0.0622	0.9439	0.0690	0.0670	0.0570	
SD ratio	1.0731	1.0592	1.0715	0.9653	1.1728	1.0501	1.0491	0.8196	

Table A.13: Simulation Result of the Classical approach (A6, B6, C6)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A6)	Classical			size:2000			**58 cases converge**			
mean	0.6708	0.8201	0.5872	0.8771	0.6822	0.9332	0.7742	0.9273	1.1093	-0.1686
bias	-0.0208	-0.1201	0.0128	-0.1271	0.0178	-0.1332	0.0258	-0.0773	-0.2093	0.3686
RMSE	0.0595	0.2312	0.0754	0.2096	0.0703	0.2209	0.0762	0.1196	0.6097	1.1103
SD ratio	0.9629	0.8883	0.9987	0.7441	0.8613	0.8452	0.9287	0.6846	0.7901	0.7756
(B6)	Classical			size:500			**42 cases converge**			
mean	0.6513	0.8910	0.6051	0.7183	0.6989	1.0365	0.7974	0.9026	1.0997	-0.1206
bias	-0.0013	-0.1910	-0.0051	0.0317	0.0011	-0.2365	0.0026	-0.0526	-0.1997	0.3206
RMSE	0.0927	0.5246	0.1055	1.1973	0.1298	0.6686	0.1230	0.1546	0.3757	0.6113
SD ratio	0.9914	0.5842	0.6092	0.5329	0.6727	1.3128	0.6435	0.6515	0.8085	0.6426
(C6)	Classical			size:200			**38 cases converge**			
mean	0.5850	0.6530	0.7185	0.1997	0.8870	0.8014	0.8344	0.7810	0.9746	-0.0062
bias	0.0650	0.0470	-0.1185	0.5503	-0.1870	-0.0014	-0.0344	0.0690	-0.0746	0.2062
RMSE	0.2126	0.5737	0.3289	3.6757	1.0736	0.4025	0.3529	0.2497	0.5979	1.1164
SD ratio	1.2214	0.7351	0.6168	0.9759	2.0262	0.6827	0.7628	0.8093	0.8747	1.0080

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.50	1.00	1.00	3.00	0.00
(A6)	Classical			size:2000			**58 cases converge**		
mean	1.0141	0.1870	0.4541	0.9863	0.3925	0.6888	0.7546	2.9305	-0.0072
bias	-0.0641	0.1130	-0.0541	0.0137	0.1075	0.3112	0.2454	0.0695	0.0072
RMSE	0.1826	0.3398	0.0863	0.1062	0.1846	0.5198	0.5944	0.2198	0.1994
SD ratio	0.8638	0.8389	0.8614	0.7947	0.7174	0.6835	27.7842	25.3780	36.4326
(B6)	Classical			size:500			**42 cases converge**		
mean	1.0785	0.0608	0.4190	1.0102	0.4148	0.7924	0.7433	2.8986	0.0083
bias	-0.1285	0.2392	-0.0190	-0.0102	0.0852	0.2076	0.2567	0.1014	-0.0083
RMSE	0.4273	0.8079	0.0998	0.2397	0.2324	0.7548	0.8795	0.4404	0.3391
SD ratio	0.6463	0.3701	0.7651	0.9504	0.5881	0.7292	14.0846	14.0072	14.4705
(C6)	Classical			size:200			**38 cases converge**		
mean	0.9977	0.0555	0.4263	1.1634	0.6580	1.1603	0.5180	2.8745	0.1975
bias	-0.0477	0.2446	-0.0263	-0.1634	-0.1580	-0.1603	0.4820	0.1255	-0.1975
RMSE	0.4646	0.9257	0.1287	0.3774	0.3936	1.0157	1.1330	0.6635	0.6316
SD ratio	0.7151	0.8087	0.8935	0.9436	0.7689	0.7708	8.9374	8.6914	9.3608

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Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A6)	Classical			size:2000			**58 cases converge**		
mean	0.4750	0.4962	0.4964	0.5037	0.6002	0.4882	0.5000	0.4931	*fixed*
bias	0.0250	0.0038	0.0036	-0.0037	-0.1002	0.0118	0.0000	0.0069	
RMSE	0.0492	0.0221	0.0194	0.0246	0.2050	0.0389	0.0243	0.0263	
SD ratio	0.9780	1.0558	0.9074	1.0448	0.6526	0.2659	1.0380	0.9087	
(B6)	Classical			size:500			**42 cases converge**		
mean	0.4692	0.4796	0.4697	0.4925	0.6424	0.4643	0.4701	0.4876	*fixed*
bias	0.0308	0.0204	0.0303	0.0075	-0.1424	0.0357	0.0299	0.0124	
RMSE	0.1016	0.0622	0.1013	0.0500	0.1985	0.0895	0.1012	0.0489	
SD ratio	1.0725	1.1471	0.8722	0.9853	0.1909	0.7839	1.0906	0.9149	
(C6)	Classical			size:200			**38 cases converge**		
mean	0.4555	0.4556	0.4524	0.4545	0.6238	0.4533	0.4762	0.4575	*fixed*
bias	0.0445	0.0444	0.0476	0.0455	-0.1238	0.0467	0.0238	0.0425	
RMSE	0.1178	0.0779	0.0929	0.1297	0.3677	0.1023	0.0748	0.1128	
SD ratio	0.9103	0.8706	0.4026	0.9967	0.4526	1.0266	0.9042	1.0367	

Table A.14: Simulation Result of the SEM approach (A7, B7, C7)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A7)	SEM			size:2000			**110 cases converge**			
mean	0.6471	0.7003	0.5987	0.7506	0.6981	0.7943	0.7996	0.8532	0.9019	0.1995
bias	0.0029	-0.0003	0.0013	-0.0006	0.0019	0.0057	0.0004	-0.0032	-0.0019	0.0005
RMSE	0.0347	0.0308	0.0242	0.0325	0.0228	0.0349	0.0231	0.0417	0.0239	0.0280
SD ratio	1.0550	1.0482	1.0670	1.0465	1.0165	1.0488	1.0646	0.9844	0.9259	0.9887
(B7)	SEM			size:500			**104 cases converge**			
mean	0.6588	0.7073	0.5941	0.7525	0.6974	0.8110	0.7923	0.8693	0.9046	0.1971
bias	-0.0088	-0.0073	0.0059	-0.0025	0.0026	-0.0110	0.0077	-0.0193	-0.0046	0.0029
RMSE	0.0653	0.0593	0.0484	0.0643	0.0443	0.0560	0.0437	0.0907	0.0564	0.0558
SD ratio	0.9663	1.0053	1.0481	1.0353	0.9835	0.8296	0.9572	1.0381	1.0931	0.9615
(C7)	SEM			size:200			**91 cases converge**			
mean	0.6398	0.7011	0.5879	0.7475	0.6934	0.8063	0.7855	0.8298	0.9174	0.1664
bias	0.0102	-0.0011	0.0121	0.0026	0.0066	-0.063	0.0145	0.0202	-0.0174	0.0336
RMSE	0.1066	0.1029	0.0719	0.1096	0.0840	0.1050	0.0768	0.1374	0.1001	0.1222
SD ratio	1.0407	1.1140	1.0129	1.1191	1.1918	1.0074	1.0576	1.0622	1.2135	1.3591

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.50	1.00	1.00	3.00	5.00
(A7)	SEM			size:2000			**110 cases converge**		
mean	0.9518	0.2996	0.4005	1.0042	0.4929	0.9746	0.9979	3.0069	5.0029
bias	-0.0018	0.0004	-0.0005	-0.0042	0.0071	0.0254	0.0021	-0.0069	-0.0029
RMSE	0.0245	0.0267	0.0238	0.0674	0.0854	0.1917	0.1823	0.1214	0.1548
SD ratio	0.9420	0.9878	1.0012	1.0914	1.0568	1.0699	1.0188	0.9825	0.9797
(B7)	SEM			size:500			**104 cases converge**		
mean	0.9586	0.2971	0.4014	0.9964	0.4862	0.9524	1.0088	3.0026	4.9883
bias	-0.0086	0.0029	-0.0014	0.0036	0.0138	0.0477	-0.0088	-0.0026	0.0117
RMSE	0.0512	0.0544	0.0464	0.1391	0.1769	0.3822	0.3542	0.2518	0.3199
SD ratio	0.9773	0.9814	0.9611	1.0689	1.0669	1.0714	0.9814	0.9858	0.9796
(C7)	SEM			size:200			**91 cases converge**		
mean	0.9580	0.2740	0.3821	1.0192	0.5556	1.1696	1.0597	2.9709	4.9405
bias	-0.0080	0.0260	0.0179	-0.0192	-0.0556	-0.1696	-0.0597	0.0291	0.0595
RMSE	0.0934	0.1149	0.0890	0.1877	0.2711	0.5510	0.6514	0.4423	0.6078
SD ratio	1.1317	1.3651	1.2508	0.9693	1.1168	1.0198	1.2366	1.1970	1.2826

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A7)	SEM			size:2000			**110 cases converge**		
mean	0.4985	0.5019	0.5025	0.4999	0.5112	0.4975	0.4992	0.5006	*fixed*
bias	0.0015	-0.0019	-0.0025	0.0001	-0.0112	0.0025	0.0008	-0.0006	
RMSE	0.0278	0.0201	0.0188	0.0178	0.0900	0.0180	0.0184	0.0208	
SD ratio	1.0551	1.0826	0.9634	0.8688	1.0705	0.8860	0.9199	0.9926	
(B7)	SEM			size:500			**104 cases converge**		
mean	0.4937	0.4984	0.4968	0.4983	0.4936	0.4936	0.5025	0.5037	*fixed*
bias	0.0063	0.0016	0.0032	0.0017	0.0064	0.0064	-0.0025	-0.0037	
RMSE	0.0574	0.0369	0.0376	0.0427	0.1606	0.0412	0.0403	0.0420	
SD ratio	1.0781	1.0067	0.9769	1.0443	0.9784	1.0108	0.9978	0.9990	
(C7)	SEM			size:200			**91 cases converge**		
mean	0.4858	0.5019	0.4969	0.4951	0.3737	0.4952	0.4965	0.5021	*fixed*
bias	0.0142	-0.0019	0.0031	0.0050	0.1269	0.0048	0.0035	-0.0021	
RMSE	0.0904	0.0593	0.0529	0.0653	0.2767	0.0606	0.0679	0.0739	
SD ratio	1.0698	1.0154	0.8667	1.0115	0.9595	0.9365	1.0741	1.1212	

Table A.15: Simulation Result of the Classical approach (A7, B7, C7)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A7)	Classical			size:2000				**61 cases converge**		
mean	0.6513	0.8684	0.5819	0.8805	0.6844	0.9389	0.7804	0.9091	1.0098	-0.0007
bias	-0.0013	-0.1684	0.0181	-0.1305	0.0156	-0.1389	0.0196	-0.0591	-0.1098	0.2007
RMSE	0.0551	0.3872	0.0783	0.4462	0.0727	0.4007	0.0876	0.1270	0.2388	0.4234
SD ratio	1.0128	0.7895	0.7054	0.9812	0.6993	0.8384	0.8144	0.7662	0.7600	0.7434
(B7)	Classical			size:500				**36 cases converge**		
mean	0.6541	0.8409	0.6152	0.8983	0.7372	0.9308	0.8213	0.9062	1.0851	-0.1131
bias	-0.0041	-0.1409	-0.0152	-0.1483	-0.0372	-0.1308	-0.0213	-0.0562	-0.1851	0.3131
RMSE	0.1126	0.4738	0.2267	0.5280	0.3012	0.3153	0.2026	0.1589	0.4802	0.7331
SD ratio	1.0105	0.9275	0.8154	0.9672	0.9556	0.6933	0.7867	0.7089	0.6505	0.5907
(C7)	Classical			size:200				**27 cases converge**		
mean	0.5836	0.7297	0.6854	0.8234	0.8359	0.9012	0.9136	0.8379	0.9335	0.0081
bias	0.0664	-0.0297	-0.0854	-0.0734	-0.1359	-0.1012	-0.1136	0.0121	-0.0335	0.1919
RMSE	0.1998	0.3198	0.4342	0.3215	0.5897	0.2998	0.4899	0.1740	0.2800	0.6800
SD ratio	1.2577	0.7607	0.8969	0.6928	2.6985	0.6791	0.8876	0.8171	0.7589	0.7328

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.50	1.00	1.00	3.00	5.00
(A7)	Classical			size:2000				**61 cases converge**	
mean	1.0204	0.1817	0.4367	1.0305	0.4212	0.7398	3.8171	3.5821	4.4030
bias	-0.0704	0.1183	-0.0367	-0.0305	0.0788	0.2602	-2.8171	-0.5821	0.5970
RMSE	0.1868	0.3172	0.0700	0.1731	0.2014	0.5846	3.7872	0.9401	0.9030
SD ratio	0.9243	0.8639	0.7441	0.6664	0.8650	0.7672	32.3205	22.7510	33.7026
(B7)	Classical			size:500				**36 cases converge**	
mean	0.9519	0.2630	0.4519	1.0415	0.4568	0.8330	5.4112	4.0172	4.4664
bias	-0.0019	0.0370	-0.0519	-0.0415	0.0432	0.1670	-4.4112	-1.0172	0.5336
RMSE	0.1881	0.2664	0.1059	0.2527	0.2643	0.7540	4.9546	1.3292	0.9143
SD ratio	0.8428	0.6609	0.8703	0.9754	0.7587	0.9616	16.3272	10.9415	12.4995
(C7)	Classical			size:200				**27 cases converge**	
mean	1.1027	-0.0338	0.4146	1.1115	0.6273	0.9941	4.4763	4.0945	4.6604
bias	-0.1527	0.3338	-0.0146	-0.1115	-0.1273	0.0059	-3.4763	-1.0945	0.3396
RMSE	0.8509	1.6823	0.1118	0.4424	0.4126	0.7961	3.9101	1.6090	1.1190
SD ratio	1.1822	1.1424	0.8634	1.2829	1.0425	0.9035	7.4332	7.9392	8.8946

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Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A7)	Classical			size:2000				**61 cases converge**	
mean	0.4657	0.4980	0.4979	0.4996	0.6040	0.4902	0.4972	0.4876	*fixed*
bias	0.0343	0.0020	0.0021	0.0004	-0.1040	0.0098	0.0028	0.0124	
RMSE	0.1319	0.0226	0.0227	0.0182	0.1839	0.0538	0.0238	0.0281	
SD ratio	0.7130	0.9163	1.0297	0.7874	0.4673	1.2379	0.9428	0.9005	
(B7)	Classical			size:500				**36 cases converge**	
mean	0.4733	0.4639	0.4768	0.4821	0.6193	0.4536	0.5033	0.4910	*fixed*
bias	0.0267	0.0361	0.0232	0.0179	-0.1193	0.0464	-0.0033	0.0090	
RMSE	0.0858	0.0926	0.0761	0.0867	0.2367	0.1171	0.0454	0.0492	
SD ratio	0.9012	1.4253	1.1883	1.3267	0.3432	0.6762	0.9526	0.9233	
(C7)	Classical			size:200				**27 cases converge**	
mean	0.4586	0.4826	0.4852	0.4715	0.6011	0.4692	0.4534	0.4727	*fixed*
bias	0.0414	0.0174	0.0148	0.0285	-0.1011	0.0308	0.0466	0.0273	
RMSE	0.1310	0.0538	0.0518	0.0799	0.2465	0.0857	0.1488	0.1015	
SD ratio	0.9597	0.6883	0.6981	0.9339	0.4727	0.8711	1.0500	1.1600	

Table A.16: Simulation Result of the SEM approach (A8, B8, C8)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A8)	SEM			size:2000			**110 cases converge**			
mean	0.6545	0.7008	0.6009	0.7486	0.7010	0.8018	0.7996	0.8511	0.9013	0.1966
bias	-0.0045	-0.0008	-0.0009	0.0014	-0.0010	-0.0018	0.0004	-0.0011	-0.0013	0.0034
RMSE	0.0379	0.0303	0.0118	0.0393	0.0143	0.0351	0.0134	0.0532	0.0198	0.0384
SD ratio	1.1128	0.9835	0.9697	1.1995	1.1355	1.0097	1.0264	1.1010	0.9925	0.9911
(B8)	SEM			size:500			**102 cases converge**			
mean	0.6492	0.6962	0.5993	0.7458	0.7010	0.8009	0.7976	0.8374	0.9033	0.1814
bias	0.0088	0.0038	0.0007	0.0042	-0.0010	-0.0009	0.0024	0.0126	-0.0033	0.0186
RMSE	0.0694	0.0681	0.0254	0.0651	0.0263	0.0704	0.0255	0.1028	0.0412	0.0926
SD ratio	1.0073	1.0956	1.0192	0.9831	1.0288	1.0016	0.9582	1.0802	1.0096	1.1234
(C8)	SEM			size:200			**91 cases converge**			
mean	0.6377	0.7049	0.5899	0.7475	0.6944	0.8070	0.7891	0.7964	0.9114	0.1688
bias	0.0123	-0.0049	0.0101	0.0025	0.0056	-0.0070	0.0109	0.0536	-0.0114	0.0312
RMSE	0.1103	0.0947	0.0496	0.1150	0.0582	0.1081	0.0505	0.1827	0.0690	0.1505
SD ratio	0.9941	0.9393	1.1168	1.0752	1.2662	0.9411	1.0493	1.2160	1.0316	1.1439

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.50	1.00	1.00	3.00	0.00
(A8)	SEM			size:2000			**110 cases converge**		
mean	0.9521	0.3018	0.4023	0.9951	0.4990	1.0130	1.0067	2.9909	-0.0045
bias	-0.0021	-0.0018	-0.0023	0.0049	0.0010	-0.0130	-0.0067	0.0091	0.0045
RMSE	0.0191	0.0420	0.0482	0.0692	0.0875	0.2484	0.0444	0.0588	0.0819
SD ratio	0.9911	1.0117	1.1117	1.0814	0.9972	1.1024	1.0970	1.0945	1.0596
(B8)	SEM			size:500			**102 cases converge**		
mean	0.9484	0.2880	0.3915	1.0086	0.5027	1.0820	1.0055	2.9956	0.0100
bias	0.0016	0.0120	0.0086	-0.0086	-0.0027	-0.0820	-0.0055	0.0044	-0.0100
RMSE	0.0341	0.0846	0.0970	0.1274	0.1699	0.4968	0.0913	0.1217	0.1720
SD ratio	0.8680	0.9923	1.1479	0.9775	0.9872	1.0578	1.0785	1.0864	1.1042
(C8)	SEM			size:200			**91 cases converge**		
mean	0.9621	0.2715	0.3788	1.0229	0.5547	1.4331	1.0337	2.9953	-0.0010
bias	-0.0121	0.0285	0.0212	-0.0229	-0.0547	-0.4331	-0.0337	0.0047	0.0010
RMSE	0.0661	0.1543	0.1575	0.1848	0.2878	1.1584	0.2112	0.2236	0.3459
SD ratio	1.0099	1.1732	1.3006	0.8691	1.0735	1.1962	1.4584	1.1628	1.3800

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A8)	SEM			size:2000			**110 cases converge**		
mean	0.5009	0.4983	0.5009	0.5007	0.4834	0.5020	0.5003	0.4993	*fixed*
bias	-0.0009	0.0017	-0.0009	-0.0007	0.0166	-0.0020	-0.0003	0.0007	
RMSE	0.0222	0.0194	0.0198	0.0174	0.1382	0.0190	0.0196	0.0204	
SD ratio	0.9101	1.0571	1.0298	0.8526	1.1702	0.9323	0.9897	0.9607	
(B8)	SEM			size:500			**104 cases converge**		
mean	0.4944	0.4975	0.4981	0.4971	0.4086	0.4959	0.4998	0.5025	*fixed*
bias	0.0056	0.0025	0.0019	0.0029	0.0915	0.0041	0.0002	-0.0025	
RMSE	0.0475	0.0347	0.0317	0.0402	0.3012	0.0347	0.0396	0.0392	
SD ratio	0.9684	0.9492	0.8259	0.9878	1.0889	0.8483	0.9943	0.9147	
(C8)	SEM			size:200			**91 cases converge**		
mean	0.4912	0.4920	0.4920	0.4977	0.1470	0.4955	0.4848	0.4923	*fixed*
bias	0.0088	0.0080	0.0080	0.0023	0.3530	0.0045	0.0152	0.0077	
RMSE	0.0791	0.0599	0.0628	0.0702	0.8280	0.0606	0.0570	0.0652	
SD ratio	0.9787	1.0366	1.0349	1.0920	1.1716	0.9351	0.8676	0.9710	

Table A.17: Simulation Result of the Classical approach (A8, B8, C8)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A8)	Classical			size:2000			**56 cases converge**			
mean	0.6540	0.8026	0.5893	0.8514	0.6855	0.9100	0.7850	0.8898	1.0713	-0.1470
bias	-0.0040	-0.1026	0.0107	-0.1014	0.0145	-0.1100	0.0150	-0.0398	-0.1713	0.3470
RMSE	0.0585	0.2216	0.0772	0.2421	0.0795	0.2539	0.0864	0.1329	0.4816	1.1586
SD ratio	0.9882	0.9716	1.0224	1.0335	1.0498	1.0402	1.0725	0.6804	1.0120	1.1806
(B8)	Classical			size:500			**45 cases converge**			
mean	0.6529	0.8203	0.5871	0.8407	0.7305	1.0464	0.8100	0.9051	1.1053	-0.2077
bias	-0.0029	-0.1203	0.0129	-0.0907	-0.0305	-0.2464	-0.0100	-0.0551	-0.2053	0.4077
RMSE	0.1193	0.3972	0.1237	0.3189	0.1414	0.8191	0.2035	0.1399	0.7466	1.3626
SD ratio	1.1382	0.7779	0.6001	0.6978	0.7493	0.8521	0.6654	0.8432	0.5848	0.6211
(C8)	Classical			size:200			**40 cases converge**			
mean	0.5944	0.8152	0.5959	0.8454	0.6865	0.8089	0.7886	0.8569	1.0742	-0.2381
bias	0.0556	-0.1152	0.0041	-0.0954	0.0135	-0.0089	0.0114	-0.0069	-0.1742	0.4381
RMSE	0.1907	0.4994	0.3278	0.4249	0.2062	0.9099	0.3150	0.1498	0.7233	1.5716
SD ratio	1.1787	0.5606	0.6879	0.6819	0.7260	0.7519	0.6439	0.7302	0.6159	0.6517

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.50	1.00	1.00	3.00	0.00
(A8)	Classical			size:2000			**56 cases converge**		
mean	0.9786	0.2493	0.4391	1.0043	0.4480	0.8500	0.7453	2.9415	0.0081
bias	-0.0286	0.0507	-0.0391	-0.0043	0.0520	0.1500	0.2547	0.0585	-0.0081
RMSE	0.1177	0.2028	0.0839	0.1358	0.2001	0.6395	0.7885	0.3659	0.2069
SD ratio	0.9108	0.8546	0.9024	0.9271	0.7221	0.6767	34.7787	39.4444	36.0773
(B8)	Classical			size:500			**45 cases converge**		
mean	0.9878	0.2025	0.4280	1.0187	0.4046	0.6497	0.7382	2.9472	0.0736
bias	-0.0378	0.0975	-0.0280	-0.0187	0.0954	0.3503	0.2618	0.0528	-0.0736
RMSE	0.3538	0.6340	0.0992	0.2703	0.2510	0.5761	1.0853	0.4985	0.3706
SD ratio	0.7690	0.9425	0.9041	1.0825	0.8673	0.7339	18.1951	15.9200	15.5793
(C8)	Classical			size:200			**40 cases converge**		
mean	1.0516	0.0731	0.4086	1.0814	0.4821	0.9257	0.6514	2.8330	-0.0178
bias	-0.1016	0.2269	-0.0086	-0.0814	0.0179	0.0743	0.3486	0.1670	0.0178
RMSE	0.4367	0.7953	0.1630	0.3229	0.3185	0.5185	1.2576	0.8275	0.6158
SD ratio	0.5771	0.5521	1.2042	0.8792	0.8899	0.5892	9.3991	10.3474	9.9909

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A8)	Classical			size:2000			**56 cases converge**		
mean	0.4799	0.4961	0.5000	0.4999	0.5770	0.4833	0.5024	0.4892	*fixed*
bias	0.0201	0.0039	0.0000	0.0001	-0.0770	0.0167	-0.0024	0.0108	
RMSE	0.0734	0.0226	0.0245	0.0176	0.2051	0.0605	0.0230	0.0273	
SD ratio	1.2253	1.1106	1.1355	0.7641	0.3991	0.9378	0.9899	0.9542	
(B8)	Classical			size:500			**45 cases converge**		
mean	0.4549	0.4768	0.4750	0.4753	0.6177	0.4524	0.4844	0.4844	*fixed*
bias	0.0451	0.0232	0.0250	0.0247	-0.1177	0.0476	0.0156	0.0156	
RMSE	0.1363	0.0504	0.0701	0.0773	0.2118	0.1314	0.0610	0.0604	
SD ratio	1.2578	0.9348	1.0032	1.0278	0.5853	0.4857	1.0985	1.0854	
(C8)	Classical			size:200			**40 cases converge**		
mean	0.4385	0.4325	0.4655	0.4636	0.5713	0.4693	0.4688	0.4619	*fixed*
bias	0.0615	0.0675	0.0345	0.0364	-0.0713	0.0307	0.0312	0.0381	
RMSE	0.1693	0.1177	0.0810	0.1128	0.2270	0.1384	0.0650	0.0905	
SD ratio	1.0526	0.7422	0.9491	1.2328	0.4161	1.0430	0.7025	0.9890	

Table A.18: Simulation Result of the SEM approach (A9, B9, C9)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A9)	SEM			size:2000			**109 cases converge**			
mean	0.6552	0.7025	0.5991	0.7521	0.6995	0.8028	0.7998	0.8555	0.9014	0.1979
bias	-0.0052	-0.0025	0.0009	-0.0021	0.0005	-0.0028	0.0002	-0.0055	-0.0014	0.0021
RMSE	0.0414	0.0282	0.0186	0.0341	0.0176	0.0347	0.0177	0.0407	0.0252	0.0227
SD ratio	1.1113	0.9677	1.0342	1.0902	0.9868	1.0268	0.9965	0.9484	1.0493	0.9954
(B9)	SEM			size:500			**99 cases converge**			
mean	0.6383	0.6979	0.5967	0.7413	0.7004	0.7921	0.7974	0.8332	0.9090	0.1936
bias	0.0117	0.0021	0.0033	0.0087	-0.0004	0.0079	0.0026	0.0168	-0.0090	0.0064
RMSE	0.0671	0.0532	0.0350	0.0626	0.0337	0.0669	0.0352	0.0760	0.0493	0.0436
SD ratio	0.9035	0.9098	0.9935	0.9871	0.9754	0.9844	1.0183	0.8855	1.0132	0.9811
(C9)	SEM			size:200			**79 cases converge**			
mean	0.6413	0.6938	0.5921	0.7535	0.6900	0.7881	0.7923	0.8071	0.9186	0.1831
bias	0.0087	0.0062	0.0079	-0.0035	0.0100	0.0119	0.0077	0.0429	-0.0186	0.0169
RMSE	0.0899	0.0774	0.0552	0.1026	0.0574	0.0921	0.0536	0.1177	0.0741	0.0715
SD ratio	0.7829	0.8310	1.0329	1.0214	1.0293	0.8467	1.0050	0.8488	0.9636	1.0372

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.00	1.00	1.00	3.00	5.00
(A9)	SEM			size:2000			**109 cases converge**		
mean	0.9507	0.2984	0.3986	0.9898	-0.0141	0.9764	1.0072	2.9919	4.9842
bias	-0.0007	0.0016	0.0014	0.0102	0.0141	0.0236	-0.0072	0.0081	0.0158
RMSE	0.0237	0.0211	0.0196	0.0754	0.0767	0.1758	0.1393	0.0940	0.1214
SD ratio	0.9879	0.9696	1.0042	0.9679	0.9421	0.9245	0.9854	1.0049	0.9681
(B9)	SEM			size:500			**99 cases converge**		
mean	0.9452	0.2852	0.3957	1.0365	0.0265	1.0876	1.0140	2.9957	5.0015
bias	0.0048	0.0048	0.0043	-0.0365	-0.0265	-0.0876	-0.0140	0.0043	-0.0015
RMSE	0.0499	0.0429	0.0351	0.1403	0.1387	0.3186	0.2711	0.1706	0.2563
SD ratio	1.0292	1.0259	0.9288	0.9129	0.8795	0.8373	0.9906	0.9357	1.0633
(C9)	SEM			size:200			**79 cases converge**		
mean	0.9647	0.2837	0.3861	1.0603	0.1130	1.2977	1.0182	2.9954	5.0114
bias	-0.0147	0.0163	0.0139	-0.0603	-0.1130	-0.2977	-0.0182	0.0047	-0.0114
RMSE	0.0734	0.0708	0.0637	0.1933	0.2262	0.5936	0.4949	0.3468	0.4191
SD ratio	0.9390	1.0587	1.0860	0.8283	0.8327	0.9166	1.1492	1.1177	1.0880

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A9)	SEM			size:2000			**109 cases converge**		
mean	0.5028	0.5009	0.4982	0.5006	0.5101	0.5023	0.5003	0.5004	*fixed*
bias	-0.0028	-0.0009	0.0018	-0.0006	-0.0101	-0.0023	-0.0003	-0.0004	
RMSE	0.0271	0.0202	0.0185	0.0208	0.0822	0.0200	0.0194	0.0222	
SD ratio	1.0270	1.0840	0.9390	0.9894	0.9253	1.0054	0.9903	1.0476	
(B9)	SEM			size:500			**99 cases converge**		
mean	0.4895	0.5038	0.5000	0.4968	0.4521	0.4939	0.5027	0.5058	*fixed*
bias	0.0105	-0.0038	0.0001	0.0032	0.0479	0.0061	-0.0027	-0.0058	
RMSE	0.0570	0.0328	0.0429	0.0429	0.1706	0.0450	0.0389	0.0381	
SD ratio	1.0809	0.8701	1.0942	1.0269	0.9347	1.1274	0.9850	0.8826	
(C9)	SEM			size:200			**79 cases converge**		
mean	0.4802	0.4955	0.5123	0.4964	0.3628	0.4760	0.4941	0.5051	*fixed*
bias	0.0198	0.0045	-0.0123	0.0036	0.1372	0.0240	0.0060	-0.0051	
RMSE	0.0839	0.0573	0.0634	0.0643	0.2766	0.0637	0.0657	0.0696	
SD ratio	1.0010	0.9814	0.9860	0.9788	0.8480	0.9641	1.0568	1.0414	

Table A.19: Simulation Result of the Classical approach (A9, B9, C9)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A9)	Classical			size:2000			**54 cases converge**			
mean	0.6995	0.7848	0.5325	0.8233	0.6453	0.9224	0.7037	0.8614	1.1216	-0.0551
bias	-0.0195	-0.0848	0.0675	-0.0733	0.0547	-0.1224	0.0963	-0.0114	-0.2216	0.2551
RMSE	0.0817	0.4168	0.3609	0.4343	0.4063	0.4041	0.3416	0.0948	0.8012	0.8734
SD ratio	1.0982	0.9062	0.9404	1.0058	1.1088	0.9330	0.9613	0.7300	0.7274	0.7123
(B9)	Classical			size:500			**27 cases converge**			
mean	0.6849	1.0304	0.3718	1.2960	0.3132	0.8931	0.7291	0.8795	1.3995	-0.3528
bias	-0.0349	-0.3304	0.2282	-0.5460	0.3868	-0.0931	0.0709	-0.0295	-0.4995	0.5528
RMSE	0.0934	0.8512	0.6072	1.4277	0.9782	0.5678	0.4365	0.0943	1.7881	2.0665
SD ratio	0.7880	0.2635	0.2771	0.2593	0.2596	0.3638	0.3943	0.9371	0.4353	0.4052
(C9)	Classical			size:200			**32 cases converge**			
mean	0.6286	0.4995	0.7833	0.5638	0.7883	0.8486	0.6512	0.8038	0.9887	0.0925
bias	0.0214	0.2005	-0.1833	0.1862	-0.0883	-0.0486	0.1488	0.0462	-0.0887	0.1075
RMSE	0.1755	1.4372	1.0556	1.0771	0.8090	1.7981	1.6533	0.2153	1.2653	1.5983
SD ratio	0.8537	0.4841	0.5156	0.4833	0.4867	0.5306	0.6026	0.8626	0.5477	0.6227

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.00	1.00	1.00	3.00	5.00
(A9)	Classical			size:2000			**54 cases converge**		
mean	0.9296	0.3228	0.4075	1.0066	-0.0496	0.9332	4.9276	3.6584	4.5863
bias	0.0204	-0.0228	-0.0075	-0.0066	0.0496	0.0668	-3.9276	-0.6584	0.4137
RMSE	0.2222	0.2374	0.0540	0.2283	0.1756	0.4565	4.9000	1.0794	0.8600
SD ratio	1.0472	1.0145	0.8982	0.3365	0.8257	0.7156	33.6966	21.8096	25.7436
(B9)	Classical			size:500			**27 cases converge**		
mean	0.9204	0.3815	0.4497	1.0095	-0.0361	0.8690	6.7528	4.2851	4.7078
bias	0.0296	-0.0815	-0.0497	-0.0095	0.0361	0.1310	-5.7528	-1.2851	0.2922
RMSE	0.7693	0.9850	0.0835	0.2073	0.1773	0.3612	6.0694	1.5318	1.0016
SD ratio	0.3066	0.3002	0.9114	0.7335	0.9445	0.9413	11.1957	8.7792	12.1742
(C9)	Classical			size:200			**32 cases converge**		
mean	1.1812	-0.0340	0.4155	1.0889	0.0813	1.0776	5.8570	4.4086	5.1283
bias	-0.2312	0.3340	-0.0155	-0.0889	-0.0813	-0.0776	-4.8570	-1.4086	-0.1283
RMSE	1.9619	2.9353	0.1211	0.3674	0.3445	0.7337	5.4914	2.6004	2.1606
SD ratio	0.5432	1.7206	0.8721	0.9888	1.0198	1.2072	10.1131	12.7621	15.0813

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A9)	Classical			size:2000			**54 cases converge**		
mean	0.4474	0.4897	0.4947	0.4937	0.5406	0.4852	0.4975	0.4930	*fixed*
bias	0.0526	0.0103	0.0053	0.0063	-0.0406	0.0148	0.0025	0.0070	
RMSE	0.2094	0.0248	0.0215	0.0302	0.1600	0.0593	0.0253	0.0293	
SD ratio	0.3498	0.7994	0.9381	1.1353	0.4712	0.4840	0.9944	1.0976	
(B9)	Classical			size:500			**27 cases converge**		
mean	0.4321	0.4813	0.4726	0.4850	0.5994	0.4766	0.4769	0.4844	*fixed*
bias	0.0679	0.0187	0.0274	0.0150	-0.0994	0.0234	0.0231	0.0156	
RMSE	0.1519	0.0447	0.0860	0.0506	0.1799	0.0954	0.0740	0.0489	
SD ratio	0.8092	0.7160	1.0865	0.9220	1.0108	1.0251	1.1084	0.9353	
(C9)	Classical			size:200			**32 cases converge**		
mean	0.4598	0.4594	0.4567	0.4461	0.6264	0.4441	0.4489	0.4883	*fixed*
bias	0.0402	0.0406	0.0433	0.0539	-0.1264	0.0559	0.0511	0.0117	
RMSE	0.1603	0.1158	0.1139	0.1120	0.2920	0.1318	0.1346	0.0772	
SD ratio	1.1134	1.0943	1.2135	0.8449	1.1737	0.9648	1.1294	0.4004	

Table A.20: Simulation Result of the SEM approach (A10, B10, C10)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A10)	SEM			size:2000				**105 cases converge**		
mean	0.6453	0.6931	0.6028	0.7441	0.7012	0.7930	0.8016	0.8399	0.8988	0.1985
bias	0.0047	0.0069	-0.0028	0.0059	-0.0012	0.0070	-0.0016	0.0101	0.0012	0.0015
RMSE	0.0452	0.0372	0.0123	0.0445	0.0128	0.0445	0.0123	0.0519	0.0201	0.0386
SD ratio	0.9900	1.0002	1.0541	1.1076	1.0903	1.0180	1.0029	1.0417	1.0620	1.0563
(B10)	SEM			size:500				**88 cases converge**		
mean	0.6333	0.6827	0.6015	0.7359	0.6992	0.7939	0.7965	0.8171	0.9043	0.1742
bias	0.0167	0.0171	-0.0015	0.0141	0.0008	0.0061	0.0035	0.0329	-0.0043	0.0258
RMSE	0.0874	0.0813	0.0229	0.0866	0.0227	0.0852	0.0217	0.1034	0.0397	0.0863
SD ratio	0.9891	1.1158	1.0158	1.1036	0.9978	1.0153	0.8926	1.0615	1.0518	1.1535
(C10)	SEM			size:200				**77 cases converge**		
mean	0.5985	0.6932	0.6049	0.7216	0.7109	0.7688	0.8006	0.7350	0.9117	0.1485
bias	0.0516	0.0069	-0.0049	0.0284	-0.0109	0.0312	-0.0006	0.1150	-0.0117	0.0515
RMSE	0.1417	0.1275	0.0413	0.1308	0.0354	0.1471	0.0364	0.1763	0.0596	0.1146
SD ratio	1.1381	1.1321	0.8716	0.8624	0.8043	1.1140	0.6026	1.2938	1.0759	1.2870

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.00	1.00	1.00	3.00	0.00
(A10)	SEM			size:2000			**105 cases converge**		
mean	0.9496	0.2962	0.3937	1.0055	0.0172	1.0490	0.9972	3.0018	0.0090
bias	0.0004	0.0038	0.0063	-0.0055	-0.0172	-0.0490	0.0028	-0.0018	-0.0090
RMSE	0.0204	0.0439	0.0486	0.0798	0.0948	0.2540	0.0364	0.0635	0.0729
SD ratio	1.1202	1.0971	1.1280	0.9675	0.9972	1.0436	0.9288	0.9978	0.9443
(B10)	SEM			size:500			**88 cases converge**		
mean	0.9551	0.2721	0.3753	1.0325	0.0462	1.2151	0.9900	3.0146	0.0250
bias	-0.0051	0.0279	0.0247	-0.0325	-0.0462	-0.2151	-0.0100	-0.0146	-0.0250
RMSE	0.0402	0.0839	0.0795	0.1483	0.1692	0.5577	0.0763	0.1139	0.1427
SD ratio	1.0816	1.0259	0.9407	0.9442	0.9628	1.0604	1.0132	0.9378	0.9853
(C10)	SEM			size:200			**77 cases converge**		
mean	0.9577	0.2981	0.3455	1.0637	0.1593	1.6228	0.9720	3.0146	0.0843
bias	-0.0076	0.0019	0.0545	-0.0637	-0.1593	-0.6228	0.0280	-0.0146	-0.0843
RMSE	0.0607	0.1334	0.1237	0.2137	0.3031	1.2993	0.1119	0.1947	0.2342
SD ratio	0.8651	1.3922	1.2235	0.8824	0.9837	1.1215	0.9146	1.0493	0.9844

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A10)	SEM			size:2000			**105 cases converge**		
mean	0.5000	0.4996	0.5009	0.5019	0.4678	0.4963	0.4995	0.4997	*fixed*
bias	0.0000	0.0004	-0.0009	-0.0019	0.0322	0.0037	0.0005	0.0003	
RMSE	0.0236	0.0194	0.0175	0.0208	0.1461	0.0201	0.0200	0.0247	
SD ratio	0.9622	1.0492	0.8924	0.9935	1.1144	0.9892	1.0193	1.0854	
(B10)	SEM			size:500			**88 cases converge**		
mean	0.4907	0.4957	0.4981	0.4934	0.3459	0.5012	0.4963	0.5048	*fixed*
bias	0.0093	0.0043	0.0019	0.0066	0.1541	-0.0012	0.0037	-0.0048	
RMSE	0.0480	0.0356	0.0356	0.0409	0.3616	0.0440	0.0382	0.0488	
SD ratio	0.9715	0.9629	0.9160	0.9819	1.1254	1.0926	0.9686	1.0631	
(C10)	SEM			size:200			**77 cases converge**		
mean	0.4848	0.4921	0.4951	0.4867	0.0963	0.4828	0.4925	0.5036	*fixed*
bias	0.0152	0.0079	0.0049	0.0133	0.4037	0.0172	0.0075	-0.0036	
RMSE	0.0893	0.0560	0.0693	0.0654	1.0248	0.0550	0.0651	0.0710	
SD ratio	1.1644	0.9586	1.1329	0.9957	1.2851	0.8436	1.0207	0.9750	

Table A.21: Simulation Result of the Classical approach (A10, B10, C10)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A10)	Classical			size:2000			**48 cases converge**			
mean	0.6616	0.8158	0.5209	0.9606	0.5309	1.0569	0.6010	0.8779	1.1281	-0.1592
bias	-0.0116	-0.1158	0.0791	-0.2106	0.1691	-0.2569	0.1990	-0.0279	-0.3181	0.3592
RMSE	0.0631	0.7531	0.5897	0.4544	0.3623	0.6570	0.5269	0.0680	0.8342	0.9288
SD ratio	0.8923	0.6345	0.6265	0.6866	0.6986	0.6546	0.6627	0.6393	0.4740	0.4692
(B10)	Classical			size:500			**41 cases converge**			
mean	0.6549	0.8360	0.4836	0.9939	0.5029	0.8888	0.7465	0.8552	1.1476	-0.1035
bias	-0.0049	-0.1360	0.1164	-0.2439	0.1971	-0.0888	0.0535	-0.0052	-0.2476	0.3035
RMSE	0.1229	0.7497	0.5910	1.0602	0.7791	1.9380	1.3728	0.1206	0.7587	0.8986
SD ratio	0.8724	0.7037	0.7399	0.6983	0.6943	0.5666	0.5659	0.7465	0.5436	0.5535
(C10)	Classical			size:200			**41 cases converge**			
mean	0.6872	0.8845	0.4192	1.0079	0.5216	0.8880	0.6995	0.7757	1.0225	0.0207
bias	-0.0372	-0.1845	0.1808	-0.2579	0.1784	-0.0880	0.1005	0.0743	-0.1225	0.1793
RMSE	0.1557	1.2999	1.2710	1.0532	0.7122	0.7127	0.6376	0.2059	0.5633	0.7426
SD ratio	0.8619	0.7583	0.8799	0.6019	0.5863	0.6838	0.7654	0.8803	0.5761	0.7311

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.00	1.00	1.00	3.00	0.00
(A10)	Classical			size:2000			**48 cases converge**		
mean	1.0846	0.1405	0.4124	0.9929	-0.0550	0.8421	1.6279	3.0450	-0.1457
bias	-0.1346	0.1595	-0.0124	0.0071	0.0550	0.1579	-0.6279	-0.0450	0.1457
RMSE	0.5258	0.6033	0.0571	0.1380	0.1278	0.3336	0.9299	0.2983	0.2578
SD ratio	0.5561	0.55315	1.0650	0.5101	0.6761	0.6760	34.7890	33.4869	32.8361
(B10)	Classical			size:500			**41 cases converge**		
mean	0.9337	0.2916	0.4045	1.0238	-0.0008	0.9244	1.8687	3.1465	-0.0486
bias	0.0163	0.0084	-0.0045	-0.0238	0.0008	0.0756	-0.8687	-0.1465	0.0486
RMSE	0.2974	0.3031	0.0764	0.2701	0.2583	0.3672	1.1555	0.4602	0.3658
SD ratio	0.7415	0.6982	0.8767	0.9991	0.9474	0.6256	14.1331	15.1847	16.7712
(C10)	Classical			size:200			**41 cases converge**		
mean	0.9827	0.3060	0.4276	1.0280	0.0679	1.2893	1.7046	2.9206	-0.0289
bias	-0.0327	-0.0060	-0.0276	-0.0280	-0.0679	-0.2893	-0.7046	0.0794	0.0289
RMSE	0.5417	0.6326	0.0949	0.3102	0.3526	0.8189	1.6752	0.8426	0.5803
SD ratio	0.5819	0.5616	0.7859	0.8854	0.9744	0.7900	13.3072	13.3918	9.4562

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A10)	Classical			size:2000			**48 cases converge**		
mean	0.4645	0.4928	0.4956	0.4976	0.5538	0.4721	0.4987	0.4921	*fixed*
bias	0.0355	0.0072	0.0044	0.0024	-0.0538	0.0279	0.0013	0.0079	
RMSE	0.1166	0.0203	0.0267	0.0272	0.1532	0.0720	0.0258	0.0280	
SD ratio	0.6315	0.8747	1.0394	1.0831	0.7266	0.4598	1.1006	0.9481	
(B10)	Classical			size:500			**41 cases converge**		
mean	0.4865	0.4719	0.4801	0.4772	0.5358	0.4768	0.4807	0.4747	*fixed*
bias	0.0135	0.0281	0.0199	0.0228	-0.0358	0.0232	0.0193	0.0253	
RMSE	0.0852	0.0774	0.0590	0.0515	0.1480	0.1029	0.0422	0.0936	
SD ratio	1.0997	1.2501	0.9792	0.1803	0.6309	0.5236	0.8228	0.9746	
(C10)	Classical			size:200			**41 cases converge**		
mean	0.4753	0.4484	0.4742	0.4580	0.5251	0.4622	0.4355	0.4847	*fixed*
bias	0.0247	0.0517	0.0258	0.0420	-0.0251	0.0378	0.0645	0.0153	
RMSE	0.1480	0.1112	0.1027	0.0887	0.2320	0.0939	0.1490	0.1140	
SD ratio	1.1702	0.9836	0.1416	0.9081	0.4300	0.9599	1.2298	1.1634	

Table A.22: Simulation Result of the SEM approach (A11, B11, C11)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A11)	SEM			size:2000			**107 cases converge**			
mean	0.6511	0.7030	0.5993	0.7565	0.6979	0.8041	0.7984	0.8458	0.9003	0.1986
bias	-0.0011	-0.0030	0.0007	-0.0065	0.0021	-0.0041	0.0016	0.0042	-0.0003	0.0014
RMSE	0.0363	0.0305	0.0183	0.0330	0.0166	0.0351	0.0167	0.0420	0.0251	0.0226
SD ratio	0.9914	1.0493	1.0296	1.0380	0.9264	1.0410	0.9463	0.9942	1.0532	1.0210
(B11)	SEM			size:500			**91 cases converge**			
mean	0.6442	0.6971	0.5961	0.7537	0.6935	0.7979	0.7920	0.8375	0.9055	0.1933
bias	0.0058	0.0029	0.0039	-0.0037	0.0065	0.0021	0.0080	0.0125	-0.0055	0.0067
RMSE	0.0557	0.0621	0.0352	0.0616	0.0350	0.0714	0.0402	0.0868	0.0536	0.0474
SD ratio	0.7591	1.0662	1.0112	0.9854	0.9853	1.0598	1.1417	1.0400	1.1208	1.0911
(C11)	SEM			size:200			**85 cases converge**			
mean	0.6085	0.6852	0.5895	0.7321	0.6914	0.7797	0.7883	0.7708	0.8916	0.1873
bias	0.0415	0.0148	0.0105	0.0180	0.0087	0.0203	0.0117	0.0792	0.0084	0.0127
RMSE	0.1134	0.1029	0.0656	0.1111	0.0624	0.1154	0.0670	0.1536	0.0935	0.0769
SD ratio	0.9181	1.1018	1.2178	1.0905	1.1530	1.0532	1.2336	0.9912	1.2476	1.1816

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.00	1.00	1.00	3.00	5.00
(A11)	SEM			size:2000			**107 cases converge**		
mean	0.9478	0.2990	0.3990	1.0029	0.0000	1.0112	0.9984	2.9947	5.0024
bias	0.0022	0.0010	0.0010	-0.0029	0.0000	-0.0112	0.0016	0.0053	-0.0024
RMSE	0.0252	0.0223	0.0197	0.0769	0.0864	0.1890	0.1448	0.0931	0.1240
SD ratio	1.0496	1.0568	1.0346	1.0121	1.0948	1.0162	1.0496	1.0181	1.0264
(B11)	SEM			size:500			**91 cases converge**		
mean	0.9533	0.2928	0.3959	1.0339	0.0219	1.1082	1.0180	3.0006	4.9927
bias	-0.0033	0.0072	0.0041	-0.0339	-0.0219	-0.1082	-0.0180	-0.0006	-0.0073
RMSE	0.0456	0.0452	0.0388	0.1311	0.1544	0.3538	0.2958	0.2027	0.2712
SD ratio	0.9455	1.0788	1.0509	0.8523	0.9946	0.9284	1.1009	1.1219	1.1362
(C11)	SEM			size:200			**85 cases converge**		
mean	0.9361	0.2865	0.3880	1.0831	0.1133	1.3294	1.0261	3.0447	5.0547
bias	0.0139	0.0135	0.0120	-0.0831	-0.1133	-0.3294	-0.0261	-0.0447	-0.0547
RMSE	0.0802	0.0732	0.0705	0.2194	0.2503	0.6727	0.5125	0.3148	0.4509
SD ratio	1.0384	1.1489	1.2079	0.8998	0.9352	1.0245	1.1972	1.0455	1.2035

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A11)	SEM			size:2000			**107 cases converge**		
mean	0.4983	0.4974	0.5035	0.4958	0.4890	0.4974	0.4987	0.4980	*fixed*
bias	0.0017	0.0026	-0.0035	0.0042	0.0110	0.0026	0.0013	0.0020	
RMSE	0.0276	0.0171	0.0206	0.0230	0.0960	0.0203	0.0202	0.0246	
SD ratio	1.0507	0.9123	1.0299	1.0875	1.0904	1.0241	1.0347	1.1640	
(B11)	SEM			size:500			**91 cases converge**		
mean	0.4935	0.5021	0.4947	0.4981	0.4357	0.4954	0.4993	0.5008	*fixed*
bias	0.0065	-0.0021	0.0053	0.0019	0.0643	0.0046	0.0007	-0.0008	
RMSE	0.0405	0.0373	0.0457	0.0416	0.1879	0.0420	0.0399	0.0411	
SD ratio	0.7655	0.9975	1.1662	0.9979	1.0157	1.0606	1.0173	0.9738	
(C11)	SEM			size:200			**85 cases converge**		
mean	0.4803	0.4852	0.5031	0.4937	0.3481	0.4944	0.4975	0.4951	*fixed*
bias	0.0197	0.0148	-0.0031	0.0063	0.1519	0.0057	0.0025	0.0050	
RMSE	0.0868	0.0579	0.0633	0.0723	0.3589	0.0711	0.0752	0.0708	
SD ratio	1.0314	0.9780	1.0192	1.1026	1.1087	1.1329	1.2087	1.0570	

Table A.23: Simulation Result of the Classical approach (A11, B11, C11)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A11)	Classical			size:2000			**55 cases converge**			
mean	0.6616	0.8184	0.5098	0.9383	0.5516	0.9820	0.6624	0.8778	1.1119	-0.0398
bias	-0.0116	-0.1184	0.0902	-0.1883	0.1484	-0.1820	0.1376	-0.0278	-0.2119	0.2398
RMSE	0.0591	0.6805	0.5533	0.5498	0.4266	0.3908	0.3065	0.0756	0.6961	0.8040
SD ratio	0.8233	0.9524	0.9844	0.9627	0.9872	0.8704	0.9282	0.7503	0.5229	0.5580
(B11)	Classical			size:500			**33 cases converge**			
mean	0.6787	0.9573	0.4172	0.9135	0.5733	1.5257	0.1513	0.8808	1.1218	-0.0398
bias	-0.0287	-0.2573	0.1828	-0.1635	0.1267	-0.7257	0.6487	-0.0308	-0.2218	0.2398
RMSE	0.0850	0.7215	0.6143	0.6017	0.5025	1.9887	1.9238	0.1078	0.7614	0.7902
SD ratio	0.7463	0.6520	0.6741	0.6539	0.6402	0.5939	0.6142	0.7335	0.6862	0.6448
(C11)	Classical			size:200			**28 cases converge**			
mean	0.5921	0.7347	0.4900	0.6042	0.8164	0.8563	0.6801	0.7757	1.3670	-0.2097
bias	0.0579	-0.0347	0.1100	0.1458	-0.1164	-0.0563	0.1199	0.0743	-0.4670	0.4097
RMSE	0.1840	0.6967	0.6803	0.5010	0.5565	0.7541	0.8128	0.1581	2.3215	1.8137
SD ratio	1.0341	0.4039	0.3482	0.3702	0.3745	0.3690	0.3473	0.7474	0.3371	0.3238

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.00	1.00	1.00	3.00	5.00
(A11)	Classical			size:2000			**55 cases converge**		
mean	0.9528	0.2871	0.4183	1.0023	-0.0569	0.8465	4.9857	3.7154	4.5359
bias	-0.0028	0.0129	-0.0183	-0.0023	0.0569	0.1535	-3.9857	-0.7154	0.4641
RMSE	0.2571	0.3042	0.0448	0.1369	0.1500	0.3470	4.8375	1.0953	0.9150
SD ratio	0.8619	0.8753	0.7432	0.7002	0.8184	0.7545	32.0001	20.8504	27.2649
(B11)	Classical			size:500			**33 cases converge**		
mean	1.0927	0.1416	0.4009	0.9719	-0.0870	0.9215	6.4114	3.9168	4.4977
bias	-0.1427	0.1584	-0.0009	0.0281	0.0869	0.0785	-5.4114	-0.9268	0.5023
RMSE	0.4562	0.5178	0.0849	0.1711	0.1833	0.4715	5.9320	1.2947	0.8162
SD ratio	0.5829	0.5835	1.0407	0.7518	0.7536	0.5933	14.6530	10.4699	9.1182
(C11)	Classical			size:200			**28 cases converge**		
mean	0.8019	0.3934	0.4391	1.1159	0.1065	1.1651	4.8091	3.9410	4.8890
bias	0.1481	-0.0934	-0.0391	-0.1159	-0.1065	-0.1651	-3.8091	-0.9410	0.1110
RMSE	0.3474	0.2926	0.1187	0.3885	0.2768	0.5001	4.4180	1.9973	1.5380
SD ratio	0.8070	0.7506	1.0641	1.1448	0.8011	0.6702	7.3798	9.1495	8.9714

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A11)	Classical			size:2000			**55 cases converge**		
mean	0.4750	0.4893	0.4986	0.4915	0.5574	0.4717	0.5028	0.4855	*fixed*
bias	0.0250	0.0107	0.0014	0.0085	-0.0574	0.0283	-0.0028	0.0145	
RMSE	0.0859	0.0390	0.0275	0.0277	0.1392	0.0913	0.0228	0.0332	
SD ratio	0.8590	1.0248	1.1089	1.0961	0.6886	0.6496	0.9449	1.1116	
(B11)	Classical			size:500			**33 cases converge**		
mean	0.4685	0.4836	0.4628	0.4673	0.5610	0.4916	0.4805	0.4862	*fixed*
bias	0.0315	0.0164	0.0372	0.0327	-0.0610	0.0084	0.0195	0.0138	
RMSE	0.0976	0.0605	0.0914	0.0978	0.1791	0.0867	0.0645	0.0505	
SD ratio	0.9484	1.1534	1.0086	0.3338	0.3598	0.8340	0.9070	0.9861	
(C11)	Classical			size:200			**28 cases converge**		
mean	0.4633	0.4645	0.4562	0.4504	0.5883	0.4686	0.4682	0.4417	*fixed*
bias	0.0367	0.0356	0.0438	0.0497	-0.0883	0.0314	0.0318	0.0583	
RMSE	0.1188	0.0851	0.0863	0.1152	0.2070	0.1239	0.1177	0.1216	
SD ratio	1.0151	1.0460	0.9400	1.0710	0.6125	0.9764	1.2506	1.0922	

Table A.24: Simulation Result of the SEM approach (A12, B12, C12)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A12)	SEM			size:2000			**108 cases converge**			
mean	0.6546	0.7070	0.5973	0.7548	0.6994	0.8033	0.8005	0.8468	0.8993	0.2039
bias	-0.0046	-0.0070	0.0027	-0.0048	0.0006	-0.0033	-0.0005	0.0032	0.0007	-0.0039
RMSE	0.0485	0.0404	0.0124	0.0416	0.0114	0.0450	0.0123	0.0461	0.0189	0.0335
SD ratio	1.0499	1.0780	1.0532	1.0293	0.9662	1.0277	1.0066	0.9674	0.9920	0.9022
(B12)	SEM			size:500			**77 cases converge**			
mean	0.6265	0.6894	0.6009	0.7403	0.6974	0.7802	0.8018	0.8018	0.9099	0.1881
bias	0.0235	0.0106	-0.0009	0.0097	0.0026	0.0198	-0.0018	0.0482	-0.0099	0.0119
RMSE	0.0715	0.0677	0.0236	0.0636	0.0214	0.0722	0.0225	0.1122	0.0360	0.0624
SD ratio	0.7923	0.9432	1.0571	0.8191	0.9282	0.8388	0.9472	1.0395	0.9221	0.8773
(C12)	SEM			size:200			**76 cases converge**			
mean	0.6210	0.6943	0.5955	0.7422	0.6896	0.7685	0.8009	0.7114	0.9057	0.1732
bias	0.0290	0.0057	0.0045	0.0078	0.0104	0.0315	-0.0009	0.1386	-0.0057	0.0268
RMSE	0.1263	0.1203	0.0520	0.1373	0.0713	0.1335	0.0482	0.2382	0.0579	0.1195
SD ratio	0.9535	1.0882	1.3698	1.1581	1.7741	1.0171	1.2021	1.2471	0.9817	1.1448

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.00	1.00	1.00	3.00	0.00
(A12)	SEM			size:2000			**108 cases converge**		
mean	0.9500	0.3043	0.4054	0.9924	0.0022	1.0242	1.0021	2.9937	0.0000
bias	0.0001	-0.0043	-0.0054	0.0076	-0.0022	-0.0242	-0.0021	0.0063	0.0000
RMSE	0.0149	0.0398	0.0454	0.0810	0.0898	0.2312	0.0404	0.0609	0.0654
SD ratio	0.8204	0.9890	1.0548	0.9508	0.9647	1.0097	1.0151	0.9332	0.8551
(B12)	SEM			size:500			**77 cases converge**		
mean	0.9496	0.2840	0.3731	1.0646	0.0906	1.2684	0.9845	3.0340	0.0573
bias	0.0004	0.0160	0.0269	-0.0646	-0.0906	-0.2684	0.0155	-0.0340	-0.0573
RMSE	0.0336	0.0734	0.0739	0.1372	0.1833	0.5780	0.0675	0.1046	0.1452
SD ratio	0.9130	0.9440	0.8517	0.8172	0.9145	1.0121	0.8976	0.8474	0.9185
(C12)	SEM			size:200			**76 cases converge**		
mean	0.9433	0.2817	0.3446	1.0921	0.2132	1.8563	0.9933	3.0533	0.1309
bias	0.0067	0.0183	0.0554	-0.0921	-0.2132	-0.8563	0.0067	-0.0533	-0.1309
RMSE	0.0616	0.1230	0.1443	0.2327	0.3500	1.5503	0.1472	0.1921	0.3195
SD ratio	1.0598	1.1168	1.1855	0.9428	1.0506	1.1830	1.2678	1.0015	1.2956

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A12)	SEM			size:2000			**108 cases converge**		
mean	0.4980	0.4998	0.4986	0.4998	0.4838	0.4996	0.4986	0.5006	*fixed*
bias	0.0020	0.0002	0.0014	0.0002	0.0162	0.0004	0.0014	-0.0006	
RMSE	0.0241	0.0191	0.0198	0.0217	0.1291	0.0198	0.0195	0.0247	
SD ratio	0.9811	1.0313	1.0166	1.0430	1.0730	0.9924	0.9959	1.0810	
(B12)	SEM			size:500			**77 cases converge**		
mean	0.4894	0.5023	0.4996	0.4977	0.3453	0.4871	0.5013	0.5045	*fixed*
bias	0.0106	-0.0023	0.0004	0.0023	0.1547	0.0129	-0.0013	-0.0045	
RMSE	0.0525	0.0408	0.0350	0.0397	0.3472	0.0389	0.0356	0.0456	
SD ratio	1.0602	1.0962	0.9002	0.9576	1.0238	0.9271	0.8952	1.0035	
(C12)	SEM			size:200			**76 cases converge**		
mean	0.4923	0.5045	0.4941	0.5039	-0.0951	0.4812	0.4911	0.5112	*fixed*
bias	0.0077	-0.0045	0.0059	-0.0039	0.5951	0.0188	0.0089	-0.0012	
RMSE	0.0777	0.0656	0.0637	0.0732	1.1985	0.0661	0.0655	0.0715	
SD ratio	0.9778	1.1065	1.0330	1.1045	1.2607	1.0131	1.02657	0.9888	

Table A.25: Simulation Result of the Classical approach (A12, B12, C12)

Design	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A12)	Classical			size:2000			**43 cases converge**			
mean	0.6658	0.8477	0.4771	0.9015	0.5819	1.0059	0.6399	0.8530	1.1111	-0.0292
bias	-0.0158	-0.1477	0.1229	-0.1515	0.1181	-0.2059	0.1601	-0.0030	-0.2111	0.2292
RMSE	0.0583	0.3727	0.3247	0.2848	0.2290	0.4218	0.3323	0.1045	0.5058	0.5254
SD ratio	0.6116	0.7837	0.8453	0.8836	0.9901	0.7848	0.8253	0.5200	0.7691	0.7389
(B12)	Classical			size:500			**39 cases converge**			
mean	0.6433	1.3704	0.1751	1.1020	0.4614	1.2282	0.5329	0.8140	1.3911	-0.4728
bias	0.0067	-0.6704	0.4249	-0.3520	0.2386	-0.4282	0.2671	0.0360	-0.4911	0.6728
RMSE	0.1482	3.2104	1.7525	1.4962	0.8031	1.9575	0.9958	0.1611	1.9684	2.8521
SD ratio	1.1021	0.4156	0.4283	0.3895	0.3827	0.3995	0.3907	0.8919	0.3924	0.3975
(C12)	Classical			size:200			**41 cases converge**			
mean	0.6418	0.5874	0.7159	0.7910	0.6962	0.6618	0.9802	0.8043	0.9453	0.1418
bias	0.0082	0.1126	-0.1159	-0.0410	0.0038	0.1382	-0.1802	0.0457	-0.0453	0.0582
RMSE	0.1622	1.1843	1.3420	0.6715	0.6948	0.9742	1.0919	0.1345	0.5405	0.5205
SD ratio	1.0138	0.7137	0.7510	0.5517	0.5705	0.6204	0.6645	0.7699	0.5916	0.6031

Design	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.95	0.30	0.40	1.00	0.00	1.00	1.00	3.00	0.00
(A12)	Classical			size:2000			**43 cases converge**		
mean	0.9907	0.2637	0.4148	0.9938	-0.0250	0.9981	1.6972	3.0687	-0.1504
bias	-0.0407	0.0363	-0.0148	0.0062	0.0250	0.0019	-0.6972	-0.0687	0.1054
RMSE	0.1401	0.1501	0.0556	0.1287	0.1834	0.5223	0.9397	0.1902	0.2622
SD ratio	0.7538	0.7420	0.6797	0.5147	0.5859	0.5147	34.5443	21.7414	37.8206
(B12)	Classical			size:500			**39 cases converge**		
mean	1.0036	0.2173	0.4138	1.0560	0.0307	1.0427	1.8614	3.2076	0.0471
bias	-0.0536	0.0827	-0.0138	-0.0560	-0.0307	-0.0427	-0.8614	-0.2076	-0.0471
RMSE	0.3647	0.3783	0.0625	0.2637	0.2999	0.5324	1.1610	0.5500	0.5097
SD ratio	0.6186	0.5673	0.6772	1.0400	1.1193	0.8450	15.4167	17.7621	20.0938
(C12)	Classical			size:200			**41 cases converge**		
mean	1.0629	0.1310	0.4108	1.0605	0.0744	1.0872	1.7150	2.9600	-0.0974
bias	-0.1129	0.1690	-0.0108	-0.0605	-0.0744	-0.0872	-0.7150	0.0400	0.0974
RMSE	0.7541	1.0843	0.1316	0.3667	0.2817	0.4940	1.0725	0.5472	0.3931
SD ratio	0.7745	1.2808	1.2493	1.1714	0.9690	0.7340	7.8653	9.5255	7.1981

Design	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A12)	Classical			size:2000			**43 cases converge**		
mean	0.4673	0.4901	0.4984	0.4970	0.5041	0.4718	0.4975	0.4975	*fixed*
bias	0.0327	0.0099	0.0016	0.0030	-0.0041	0.0282	0.0025	0.0025	
RMSE	0.1029	0.0341	0.0233	0.0365	0.1778	0.0827	0.0255	0.0264	
SD ratio	0.9354	0.8443	1.0638	0.9079	0.3252	0.8873	1.0704	1.0100	
(B12)	Classical			size:500			**39cases converge**		
mean	0.4562	0.4802	0.4817	0.4787	0.5461	0.4697	0.4777	0.4716	*fixed*
bias	0.0438	0.0198	0.0183	0.0213	-0.0461	0.0303	0.0223	0.0284	
RMSE	0.0953	0.0944	0.0547	0.0534	0.1663	0.0893	0.0743	0.1004	
SD ratio	1.1059	1.2098	0.9648	0.9525	0.5591	1.0936	1.0981	1.0071	
(C12)	Classical			size:200			**41 cases converge**		
mean	0.4631	0.4470	0.4692	0.4595	0.5442	0.4467	0.4517	0.4578	*fixed*
bias	0.0369	0.0530	0.0308	0.0405	-0.0442	0.0533	0.0483	0.0422	
RMSE	0.1219	0.1042	0.1152	0.1039	0.2329	0.1071	0.1057	0.0857	
SD ratio	0.9331	0.9838	0.5289	1.0425	0.7155	0.9279	0.9801	0.8686	

Table A.26: Simulation Result of the SEM approach (A13, B13, C13)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A13)	SEM			size:2000			**110 cases converge**			
mean	0.2990	0.3448	0.6018	0.3979	0.7011	0.4433	0.8023	0.4851	0.5459	0.2003
bias	0.0010	0.0052	-0.0018	0.0021	-0.0011	0.0067	-0.0023	0.0149	0.0041	-0.0003
RMSE	0.0586	0.0446	0.0108	0.0471	0.0105	0.0547	0.0130	0.0965	0.0264	0.0110
SD ratio	0.9233	0.9459	1.0031	0.8909	0.9247	0.9229	1.0671	0.9844	0.8812	1.0475
(B13)	SEM			size:500			**109 cases converge**			
mean	0.2972	0.3519	0.5981	0.3984	0.7003	0.4429	0.8031	0.4767	0.5483	0.1971
bias	0.0028	-0.0019	0.0019	0.0016	-0.0003	0.0071	-0.0031	0.0233	0.0017	0.0029
RMSE	0.1282	0.0978	0.0201	0.1188	0.0273	0.1288	0.0269	0.2479	0.0661	0.0260
SD ratio	1.0107	1.0559	0.9470	1.1425	1.2124	1.1086	1.1247	1.2516	1.1608	1.2487
(C13)	SEM			size:200			**100 cases converge**			
mean	0.2958	0.3486	0.6019	0.4052	0.6974	0.4547	0.7996	0.4460	0.5576	0.1958
bias	0.0042	0.0014	-0.0019	-0.0052	0.0026	-0.0047	0.0004	0.0540	-0.0076	0.0042
RMSE	0.2219	0.1716	0.0435	0.2065	0.0504	0.2145	0.0509	0.3814	0.1111	0.0457
SD ratio	1.1524	1.2150	1.2716	1.3077	1.3680	1.2152	1.2886	1.2577	1.2600	1.3521

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	3.00	0.50	5.00	1.00	3.00	5.00
(A13)	SEM			size:2000			**110 cases converge**		
mean	0.6014	0.2986	0.3986	3.0035	0.5196	5.0400	1.0015	2.9976	5.0128
bias	-0.0014	0.0014	0.0014	-0.0035	-0.0196	-0.0400	-0.0015	0.0024	-0.0128
RMSE	0.0306	0.0127	0.0119	0.1331	0.1656	0.3910	0.0994	0.0835	0.1209
SD ratio	0.9653	1.0314	0.9685	0.9835	1.0274	0.9709	1.0492	1.0566	1.0031
(B13)	SEM			size:500			**109 cases converge**		
mean	0.6051	0.2960	0.3979	2.9757	0.4999	5.1220	1.0044	3.0113	5.0405
bias	-0.0052	0.0040	0.0021	0.0243	0.0001	-0.1220	-0.0044	-0.0113	-0.0405
RMSE	0.0632	0.0293	0.0331	0.2459	0.3539	1.0648	0.2417	0.1583	0.2854
SD ratio	1.0423	1.2168	1.3924	0.9023	1.1195	1.2563	1.2903	0.9837	1.0508
(C13)	SEM			size:200			**100 cases converge**		
mean	0.6034	0.2951	0.3968	2.9291	0.5166	5.2276	0.9863	3.0240	5.0746
bias	-0.0034	0.0050	0.0032	0.0709	-0.0166	-0.2276	0.0137	-0.0240	-0.0746
RMSE	0.1174	0.0485	0.0457	0.4497	0.5219	1.6294	0.3609	0.2853	0.5158
SD ratio	1.2915	1.3285	1.3041	1.0644	1.1095	1.2203	1.2616	1.1296	1.1591

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A13)	SEM			size:2000			**110 cases converge**		
mean	0.5046	0.4981	0.4996	0.5008	0.4656	0.5005	0.4964	0.4997	*fixed*
bias	-0.0046	0.0019	0.0004	-0.0008	0.0344	-0.0005	0.0036	0.0003	
RMSE	0.0299	0.0181	0.0219	0.0198	0.1909	0.0216	0.0205	0.0223	
SD ratio	1.0336	0.9702	1.1023	0.9122	0.9551	1.0089	0.9336	0.9585	
(B13)	SEM			size:500			**109 cases converge**		
mean	0.4970	0.5003	0.4946	0.4977	0.3637	0.4961	0.4991	0.4984	*fixed*
bias	0.0030	-0.0003	0.0054	0.0023	0.1363	0.0039	0.0009	0.0016	
RMSE	0.0579	0.0305	0.0433	0.0406	0.6673	0.0402	0.0406	0.0462	
SD ratio	1.0163	0.8178	1.0844	0.9318	1.3981	0.9376	0.9344	0.9926	
(C13)	SEM			size:200			**100 cases converge**		
mean	0.4867	0.4952	0.4913	0.4990	0.2210	0.4778	0.4941	0.5040	*fixed*
bias	0.0133	0.0048	0.0087	0.0010	0.2790	0.0222	0.0059	-0.0040	
RMSE	0.1116	0.0581	0.0602	0.0679	1.0954	0.0872	0.0837	0.0760	
SD ratio	1.1410	0.9849	0.9484	0.9816	1.2991	1.1755	1.2025	1.0215	

Table A.27: Simulation Result of the Classical approach (A13, B13, C13)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A13)	Classical			size:2000			**92 cases converge**			
mean	0.3678	0.4024	0.5855	0.4610	0.6826	0.5206	0.7811	0.5060	0.5578	0.1976
bias	-0.0678	-0.0524	0.0145	-0.0610	0.0174	-0.0706	0.0189	-0.0060	-0.0078	0.0024
RMSE	0.1988	0.1531	0.0408	0.1753	0.0468	0.2070	0.0631	0.2602	0.0488	0.0158
SD ratio	1.0382	0.9938	1.2413	0.9865	1.2693	1.0239	1.5395	0.7771	0.8201	0.7885
(B13)	Classical			size:500			**63 cases converge**			
mean	0.4832	0.5182	0.5273	0.6045	0.6289	0.6359	0.7594	0.6148	0.6086	0.1764
bias	-0.1832	-0.1682	0.0727	-0.2045	0.0711	-0.1859	0.0405	-0.1148	-0.0586	0.0236
RMSE	0.3505	0.3142	0.1734	0.3426	0.1367	0.3434	0.1517	0.2951	0.1822	0.0951
SD ratio	0.9932	0.9299	1.0449	0.9302	0.9886	0.8749	1.1009	0.7687	0.8134	0.7910
(C13)	Classical			size:200			**48 cases converge**			
mean	0.4896	0.4850	0.6069	0.6208	0.6163	0.6330	0.7552	0.5994	0.6161	0.1791
bias	-0.1896	-0.1350	-0.0069	-0.2208	0.0837	-0.1830	0.0448	-0.0994	-0.0661	0.0209
RMSE	0.3531	0.3966	0.4261	0.3933	0.2097	0.3680	0.1500	0.3210	0.1658	0.0703
SD ratio	0.7393	0.6388	0.8853	0.7098	0.6963	0.7768	0.8304	0.7004	0.8058	0.6973

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	3.00	0.50	5.00	1.00	3.00	5.00
(A13)	Classical			size:2000			**92 cases converge**		
mean	0.5989	0.3053	0.4078	2.8792	0.4000	4.9527	1.3845	2.9299	4.9135
bias	0.0011	-0.0053	-0.0078	0.1208	0.1000	0.0473	-0.3845	0.0701	0.0865
RMSE	0.0406	0.0254	0.0391	0.3821	0.4246	1.1082	0.7436	0.3995	0.5418
SD ratio	0.9090	0.7634	0.8339	1.1537	0.9491	0.8271	32.1240	60.4398	80.5255
(B13)	Classical			size:500			**63 cases converge**		
mean	0.6166	0.3045	0.4226	2.6645	0.1344	4.5939	1.8580	2.6097	4.5167
bias	-0.0167	-0.0045	-0.0227	0.3355	0.3656	0.4061	-0.8580	0.3903	0.4833
RMSE	0.1009	0.0501	0.0511	0.7160	0.7019	1.2231	1.3286	0.8828	0.8307
SD ratio	0.8899	0.7795	0.7882	0.9525	0.9545	0.7383	19.2628	38.2196	35.4965
(C13)	Classical			size:200			**48 cases converge**		
mean	0.6318	0.2906	0.4242	2.6490	0.1407	4.6048	2.0848	2.6254	4.4573
bias	-0.0318	0.0094	-0.0242	0.3510	0.3593	0.3952	-1.0848	0.3746	0.5427
RMSE	0.1919	0.1100	0.0670	0.7464	0.7428	1.6341	1.4760	0.8779	0.9645
SD ratio	0.7790	0.7508	0.8758	0.7570	0.8090	0.9667	11.1118	19.3568	19.3989

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A13)	Classical			size:2000			**92 cases converge**		
mean	0.4934	0.4980	0.5007	0.5014	0.6936	0.4967	0.4985	0.4924	*fixed*
bias	0.0066	0.0020	-0.0007	-0.0014	-0.1936	0.0033	0.0015	0.0076	
RMSE	0.0379	0.0172	0.0219	0.0201	0.4537	0.0247	0.0210	0.0294	
SD ratio	0.9308	0.9018	1.0671	0.8798	0.5002	0.9499	0.8858	0.9666	
(B13)	Classical			size:500			**63 cases converge**		
mean	0.4248	0.4960	0.4811	0.4948	0.7871	0.4689	0.5050	0.4833	*fixed*
bias	0.0752	0.0040	0.0189	0.0052	-0.2871	0.0311	-0.0050	0.0167	
RMSE	0.2088	0.0381	0.0683	0.0446	0.4826	0.1017	0.0512	0.0535	
SD ratio	0.9870	0.9095	1.2176	0.9375	0.4333	0.8024	1.0905	0.9071	
(C13)	Classical			size:200			**48 cases converge**		
mean	0.4092	0.4868	0.4665	0.4936	0.8516	0.4407	0.4818	0.4860	*fixed*
bias	0.0908	0.0132	0.0335	0.0064	-0.3516	0.0593	0.0182	0.0140	
RMSE	0.2193	0.0848	0.0669	0.0736	0.6793	0.1201	0.0882	0.0851	
SD ratio	1.0338	1.1678	0.7956	0.9650	0.5408	0.9362	1.1269	0.9650	

Table A.28: Simulation Result of the SEM approach (A14, B14, C14)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A14)	SEM			size:2000			**110 cases converge**			
mean	0.2979	0.3522	0.5990	0.3970	0.7000	0.4497	0.7993	0.4973	0.5513	0.1988
bias	0.0021	-0.0022	0.0010	0.0030	0.0000	0.0003	0.0007	0.0027	-0.0013	0.0012
RMSE	0.0804	0.0553	0.0111	0.0660	0.0137	0.0741	0.0139	0.1043	0.0191	0.0129
SD ratio	1.1320	1.0507	0.9235	1.1090	1.0796	1.1119	1.0109	1.2372	0.9944	1.0147
(B14)	SEM			size:500			**108 cases converge**			
mean	0.3028	0.3480	0.6003	0.3953	0.6995	0.4538	0.7988	0.4596	0.5507	0.2007
bias	-0.0028	0.0020	-0.0003	0.0047	0.0005	-0.0038	0.0012	0.0404	-0.0007	-0.0007
RMSE	0.1321	0.0975	0.0246	0.1087	0.0295	0.1180	0.0279	0.2144	0.0377	0.0268
SD ratio	0.9099	0.9237	1.0400	0.9074	1.1528	0.8770	1.0162	1.1780	1.0109	1.0695
(C14)	SEM			size:200			**99 cases converge**			
mean	0.3216	0.3732	0.5923	0.4271	0.6894	0.4739	0.7900	0.3602	0.5469	0.2000
bias	-0.0216	-0.0232	0.0077	-0.0271	0.0106	-0.0239	0.0100	0.1398	0.0031	0.0000
RMSE	0.2507	0.1920	0.0445	0.2112	0.0469	0.2499	0.0566	0.4505	0.0614	0.0402
SD ratio	1.0713	1.1468	1.0832	1.1032	1.0584	1.1729	1.2012	1.3464	1.0929	1.0643

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	3.00	0.50	5.00	1.00	3.00	0.00
(A14)	SEM			size:2000			**110 cases converge**		
mean	0.6005	0.3003	0.4002	2.9837	0.4807	5.0005	1.0061	2.9991	-0.0028
bias	-0.0005	-0.0003	-0.0002	0.0163	0.0193	-0.0005	-0.0061	0.0009	0.0028
RMSE	0.0187	0.0168	0.0207	0.1512	0.1746	0.4927	0.0837	0.1072	0.1407
SD ratio	1.0249	1.0336	1.0229	1.0987	1.0820	1.1619	1.1123	1.1191	1.0896
(B14)	SEM			size:500			**108 cases converge**		
mean	0.6001	0.2973	0.3963	2.9725	0.4764	5.2079	1.0107	2.9936	0.0001
bias	-0.0001	0.0027	0.0037	0.0275	0.0236	-0.2079	-0.0107	0.0064	-0.0001
RMSE	0.0368	0.0315	0.0394	0.3069	0.3347	1.1294	0.1732	0.1897	0.2918
SD ratio	1.0166	0.9881	0.9871	1.0694	1.0115	1.2173	1.1382	0.9261	1.1020
(C14)	SEM			size:200			**99 cases converge**		
mean	0.5985	0.2951	0.3889	2.8877	0.5423	5.7418	1.0339	2.9314	0.0466
bias	0.0015	0.0049	0.0111	0.1123	-0.0423	-0.7418	-0.0339	0.0686	-0.0466
RMSE	0.0579	0.0564	0.0742	0.5000	0.5841	2.2401	0.3466	0.4171	0.5723
SD ratio	1.0253	1.1720	1.2430	0.9837	1.0692	1.2144	1.4615	1.0952	1.3288

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A14)	SEM			size:2000			**110 cases converge**		
mean	0.5013	0.4991	0.4986	0.5015	0.4710	0.5013	0.4989	0.5030	*fixed*
bias	-0.0013	0.0009	0.0014	-0.0015	0.0290	-0.0013	0.0011	-0.0030	
RMSE	0.0310	0.0170	0.0188	0.0213	0.2916	0.0199	0.0210	0.0262	
SD ratio	1.0629	0.9176	0.9473	0.9792	1.2013	0.9611	1.0444	1.0320	
(B14)	SEM			size:500			**108 cases converge**		
mean	0.5010	0.4923	0.5014	0.4961	0.3475	0.4933	0.4948	0.5034	*fixed*
bias	-0.0010	0.0077	-0.0014	0.0039	0.1525	0.0067	0.0052	-0.0034	
RMSE	0.0626	0.0386	0.0436	0.0444	0.7604	0.0419	0.0391	0.0532	
SD ratio	1.0773	1.0278	1.0910	1.0246	1.3117	1.0186	0.9588	1.0580	
(C14)	SEM			size:200			**99 cases converge**		
mean	0.4775	0.4910	0.5056	0.4999	-0.2047	0.4929	0.4947	0.5112	*fixed*
bias	0.0225	0.0090	-0.0056	0.0001	0.7047	0.0071	0.0053	-0.0112	
RMSE	0.1043	0.0505	0.0631	0.0710	1.8634	0.0681	0.0714	0.0887	
SD ratio	1.0580	0.8502	0.9848	1.0283	1.3894	1.0696	1.1004	1.1192	

Table A.29: Simulation Result of the Classical approach (A14, B14, C14)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A14)	Classical			size:2000				**91 cases converge**		
mean	0.3284	0.3821	0.5853	0.4354	0.6837	0.4937	0.7812	0.4855	0.5523	0.1964
bias	-0.0284	-0.0321	0.0147	-0.0354	0.0163	-0.0437	0.0188	0.0145	-0.0023	0.0036
RMSE	0.1879	0.1537	0.0452	0.1787	0.0487	0.2121	0.0592	0.2505	0.0478	0.0175
SD ratio	1.0713	1.0442	1.3413	1.0594	1.2761	1.1086	1.4034	0.7182	0.8383	0.8831
(B14)	Classical			size:500				**52 cases converge**		
mean	0.4373	0.5000	0.5496	0.5390	0.6658	0.6606	0.7272	0.5908	0.5979	0.1944
bias	-0.1373	-0.1500	0.0504	-0.1390	0.0342	-0.2106	0.0728	-0.0908	-0.0479	0.0056
RMSE	0.3652	0.2934	0.1064	0.3327	0.2245	0.3843	0.1454	0.3300	0.1526	0.0574
SD ratio	1.2003	1.1226	1.1057	0.9123	1.0501	1.0763	1.1503	0.8533	1.1626	1.0389
(C14)	Classical			size:200				**52 cases converge**		
mean	0.4362	0.5900	0.4320	0.6014	0.6172	0.6301	0.7306	0.6458	0.5749	0.1912
bias	-0.1362	-0.2400	0.1680	-0.2014	0.0828	-0.1801	0.0694	-0.1458	-0.0249	0.0088
RMSE	0.3962	0.6380	0.7331	0.4145	0.2102	0.4470	0.2613	0.2905	0.1945	0.0860
SD ratio	0.9607	0.9169	1.0494	0.8266	0.7128	0.8619	0.9282	0.6814	0.7661	0.6489

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	3.00	0.50	5.00	1.00	3.00	0.00
(A14)	Classical			size:2000				**91 cases converge**	
mean	0.5964	0.3017	0.4031	2.9285	0.4310	5.0267	0.9489	2.9127	-0.0507
bias	0.0036	-0.0017	-0.0031	0.0715	0.0690	-0.0267	0.0511	0.0873	0.0507
RMSE	0.0454	0.0254	0.0388	0.3155	0.4061	1.0296	0.2950	0.3019	0.3124
SD ratio	1.0359	0.7724	0.8136	1.0586	0.9387	0.7425	33.6441	84.7595	101.6448
(B14)	Classical			size:500				**52 cases converge**	
mean	0.5701	0.3216	0.4318	2.7350	0.1696	4.5732	0.9185	2.6731	-0.2509
bias	0.0299	-0.0216	-0.0318	0.2650	0.3304	0.4268	0.0815	0.3269	0.2509
RMSE	0.0999	0.0547	0.0570	0.8231	0.7189	1.3840	0.4388	0.6051	0.5004
SD ratio	1.1380	1.0046	0.8772	1.2879	1.0936	1.0565	16.7256	40.3887	39.4418
(C14)	Classical			size:200				**52 cases converge**	
mean	0.6199	0.2984	0.4311	2.6424	0.2324	4.4848	0.7742	2.6119	-0.2853
bias	-0.0199	0.0016	-0.0311	0.3576	0.2676	0.5152	0.2258	0.3881	0.2853
RMSE	0.2105	0.0960	0.0659	0.8612	0.6896	1.4676	0.5273	0.6482	0.4957
SD ratio	0.8544	0.7053	0.8856	1.0066	0.8425	0.8917	9.0824	18.8449	17.1224

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A14)	Classical			size:2000				**91 cases converge**	
mean	0.4829	0.4996	0.4979	0.4996	0.6221	0.5006	0.5001	0.4973	*fixed*
bias	0.0171	0.0004	0.0021	0.0004	-0.1221	-0.0007	-0.0001	0.0027	
RMSE	0.0641	0.0183	0.0204	0.0232	0.3607	0.0228	0.0263	0.0310	
SD ratio	1.1429	0.9650	0.9846	1.0171	0.3604	0.9010	1.1058	1.0342	
(B14)	Classical			size:500				**52 cases converge**	
mean	0.4152	0.4850	0.5009	0.4863	0.9285	0.4633	0.5028	0.4746	*fixed*
bias	0.0848	0.0150	-0.0009	0.0137	-0.4285	0.0367	-0.0028	0.0254	
RMSE	0.2059	0.0424	0.0524	0.0559	0.6492	0.0908	0.0444	0.0590	
SD ratio	1.1175	0.9890	0.3917	1.1166	0.5460	1.1170	1.0049	1.0048	
(C14)	Classical			size:200				**52 cases converge**	
mean	0.4061	0.4594	0.4805	0.4727	0.9199	0.4810	0.4816	0.4858	*fixed*
bias	0.0939	0.0406	0.0195	0.0273	-0.4199	0.0190	0.0184	0.0142	
RMSE	0.2431	0.0960	0.0713	0.1012	0.6384	0.0831	0.0886	0.1093	
SD ratio	1.2298	0.7782	0.9345	1.2275	0.6132	1.0282	1.0833	1.2329	

Table A.30: Simulation Result of the SEM approach (A15, B15, C15)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A15)	SEM			size:2000				**110 cases converge**		
mean	0.3068	0.3510	0.6011	0.4009	0.7011	0.4583	0.7996	0.5084	0.5503	0.2003
bias	-0.0068	-0.0010	-0.0011	-0.0009	-0.0011	-0.0083	0.0004	-0.0084	-0.0003	-0.0003
RMSE	0.0665	0.0476	0.0112	0.0539	0.0116	0.0599	0.0118	0.1016	0.0317	0.0113
SD ratio	1.0407	1.0165	1.0461	1.0239	1.0181	1.0103	0.9781	1.0758	1.0710	1.0693
(B15)	SEM			size:500				**109 cases converge**		
mean	0.3063	0.3466	0.6032	0.3962	0.7017	0.4576	0.8001	0.4392	0.5344	0.1988
bias	-0.0063	0.0034	-0.0032	0.0038	-0.0017	-0.0076	-0.0001	0.0608	0.0156	0.0012
RMSE	0.1476	0.0995	0.0203	0.1131	0.0233	0.1292	0.0247	0.2734	0.0684	0.0282
SD ratio	1.0694	0.9904	0.9470	0.9972	1.0369	1.0152	1.0203	1.2749	1.1628	1.3424
(C15)	SEM			size:200				**96 cases converge**		
mean	0.2874	0.3688	0.5914	0.4016	0.6945	0.4629	0.7901	0.4939	0.5621	0.1993
bias	0.0126	-0.0188	0.0086	-0.0016	0.0055	-0.0129	0.0099	0.0061	-0.0121	0.0007
RMSE	0.2195	0.1664	0.0369	0.1923	0.0408	0.1886	0.0419	0.3394	0.0884	0.0412
SD ratio	1.0978	1.1689	1.0828	1.2099	1.1541	1.0519	1.0855	1.2565	0.9965	1.3164

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	3.00	0.50	5.00	1.00	3.00	5.00
(A15)	SEM			size:2000			**110 cases converge**		
mean	0.6041	0.2998	0.4007	2.9645	0.4751	4.9422	0.9989	2.9958	4.9967
bias	-0.0041	0.0002	-0.0007	0.0355	0.0249	0.0578	0.0011	0.0042	0.0033
RMSE	0.0305	0.0135	0.0135	0.1357	0.1578	0.3905	0.1155	0.0873	0.1121
SD ratio	0.9577	1.1152	1.1301	0.9670	0.9822	0.9909	1.2193	1.1008	0.9401
(B15)	SEM			size:500			**109 cases converge**		
mean	0.5895	0.2977	0.3951	2.9808	0.5811	5.1981	0.9904	3.0312	5.0828
bias	0.0105	0.0023	0.0049	0.0192	-0.0811	-0.1981	0.0096	-0.0312	-0.0828
RMSE	0.0623	0.0303	0.0337	0.3635	0.3772	1.0958	0.3620	0.3124	0.4120
SD ratio	1.0074	1.2191	1.3220	1.1565	1.0738	1.2144	1.6272	1.3444	1.3202
(C15)	SEM			size:200			**96 cases converge**		
mean	0.5883	0.3022	0.4046	2.9694	0.4626	5.0434	0.9611	3.0421	4.9970
bias	0.0117	-0.0022	-0.0046	0.0306	0.0374	-0.0434	0.0389	-0.0421	0.0030
RMSE	0.1032	0.0428	0.0428	0.4488	0.5356	1.3707	0.3791	0.2613	0.4731
SD ratio	1.1438	1.2777	1.2769	1.0230	1.1412	1.1716	1.3296	0.9866	1.1881

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A15)	SEM			size:2000			**110 cases converge**		
mean	0.5011	0.5017	0.4997	0.4995	0.5003	0.5009	0.4978	0.4994	*fixed*
bias	-0.0011	-0.0017	0.0003	0.0005	-0.0003	-0.0009	0.0022	0.0006	
RMSE	0.0305	0.0186	0.0200	0.0209	0.1933	0.0227	0.0212	0.0218	
SD ratio	1.0675	0.9963	1.0055	0.9643	1.0307	1.0559	0.9744	0.9406	
(B15)	SEM			size:500			**109 cases converge**		
mean	0.5022	0.5004	0.4976	0.4977	0.3119	0.4955	0.4991	0.4988	*fixed*
bias	-0.0022	-0.0004	0.0024	0.0023	0.1881	0.0045	0.0009	0.0012	
RMSE	0.0562	0.0366	0.0347	0.0464	0.7811	0.0426	0.0365	0.0471	
SD ratio	0.9816	0.9827	0.8704	1.0655	1.4697	0.9999	0.8459	1.0009	
(C15)	SEM			size:200			**96 cases converge**		
mean	0.4709	0.4902	0.4983	0.4957	0.3746	0.4876	0.4881	0.4911	*fixed*
bias	0.0291	0.0098	0.0017	0.0043	0.1254	0.0124	0.0119	0.0089	
RMSE	0.1045	0.0598	0.0698	0.0636	0.7983	0.0676	0.0682	0.0879	
SD ratio	1.1120	1.0085	1.1055	0.9241	1.2480	0.9737	1.0176	1.2102	

Table A.31: Simulation Result of the Classical approach (A15, B15, C15)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A15)	Classical			size:2000			**87 cases converge**			
mean	0.3463	0.3799	0.5935	0.4403	0.6921	0.5004	0.7869	0.4998	0.5597	0.1968
bias	-0.0463	-0.0299	0.0065	-0.0403	0.0079	-0.0504	0.0131	0.0002	-0.0097	0.0032
RMSE	0.1569	0.1243	0.0307	0.1422	0.0294	0.1627	0.0338	0.2533	0.0538	0.0170
SD ratio	0.8044	0.8225	1.1358	0.8013	0.9511	0.7990	0.9337	0.6823	0.8798	0.8429
(B15)	Classical			size:500			**60 cases converge**			
mean	0.4308	0.4754	0.5633	0.5528	0.6377	0.6181	0.7514	0.5724	0.5860	0.1880
bias	-0.1308	-0.1254	0.0367	-0.1528	0.0623	-0.1681	0.0486	-0.0724	-0.0360	0.0120
RMSE	0.3426	0.2745	0.0886	0.3387	0.1195	0.3381	0.1228	0.3201	0.1092	0.0393
SD ratio	1.0763	1.0521	0.9985	1.0836	0.9620	0.9276	0.9553	0.6869	0.8772	0.7607
(C15)	Classical			size:200			**52 cases converge**			
mean	0.4435	0.5231	0.5204	0.5960	0.6020	0.6608	0.6968	0.5837	0.5843	0.1943
bias	-0.1435	-0.1731	0.0796	-0.1960	0.0980	-0.2108	0.1032	-0.0837	-0.0343	0.0057
RMSE	0.4474	0.3899	0.1801	0.4728	0.2797	0.4929	0.2386	0.4036	0.2355	0.1216
SD ratio	0.9611	0.7715	0.5591	0.7725	0.6882	0.7384	0.5524	0.7339	0.7672	0.6935

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	3.00	0.50	5.00	1.00	3.00	5.00
(A15)	Classical			size:2000			**87 cases converge**		
mean	0.6055	0.3024	0.4044	2.8871	0.4171	4.9892	1.4000	3.0202	4.9954
bias	-0.0055	-0.0025	-0.0044	0.1129	0.0829	0.0108	-0.4000	-0.0202	0.0046
RMSE	0.0416	0.0268	0.0403	0.2944	0.3579	1.1037	0.6343	0.2921	0.4906
SD ratio	0.9170	0.7913	0.8036	0.8660	0.7503	0.6779	24.5047	46.7946	78.3074
(B15)	Classical			size:500			**60 cases converge**		
mean	0.5961	0.3068	0.4216	2.7445	0.2742	4.6543	1.8643	2.7146	4.6554
bias	0.0039	-0.0068	-0.0216	0.2555	0.2258	0.3457	-0.8643	0.2854	0.3446
RMSE	0.0991	0.0410	0.0541	0.6840	0.6531	1.4396	1.3164	0.7944	0.8154
SD ratio	0.9500	0.6644	0.7721	1.0732	0.9546	0.8294	20.6675	35.9050	38.4485
(C15)	Classical			size:200			**52 cases converge**		
mean	0.5728	0.3078	0.4322	2.6594	0.1539	4.5960	2.0190	2.6630	4.5053
bias	0.0272	-0.0078	-0.0322	0.3406	0.3461	0.4040	-1.0190	0.3370	0.4947
RMSE	0.2113	0.0937	0.0744	0.8481	0.8448	1.6381	1.4012	1.0845	1.0202
SD ratio	0.7585	0.5030	0.8675	0.8220	0.8706	0.8317	12.4220	21.4716	19.1378

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A15)	Classical			size:2000			**87 cases converge**		
mean	0.4919	0.5020	0.4977	0.5014	0.7233	0.4965	0.4976	0.4959	*fixed*
bias	0.0081	-0.0020	0.0023	-0.0014	-0.2233	0.0035	0.0024	0.0041	
RMSE	0.0395	0.0189	0.0217	0.0209	0.4120	0.0265	0.0204	0.0280	
SD ratio	1.0213	0.9908	1.0588	0.9211	0.3282	1.0189	0.8439	0.9165	
(B15)	Classical			size:500			**60 cases converge**		
mean	0.4529	0.4921	0.4861	0.4849	0.8469	0.4708	0.5032	0.4828	*fixed*
bias	0.0471	0.0079	0.0139	0.0151	-0.3469	0.0292	-0.0032	0.0172	
RMSE	0.1377	0.0473	0.0503	0.0631	0.5927	0.0624	0.0390	0.0556	
SD ratio	1.1504	1.1934	1.0541	1.2647	0.4691	0.9504	0.8396	0.9591	
(C15)	Classical			size:200			**52 cases converge**		
mean	0.3914	0.4690	0.4955	0.4829	1.0723	0.4589	0.4871	0.4579	*fixed*
bias	0.1086	0.0310	0.0045	0.0171	-0.5723	0.0411	0.0129	0.0421	
RMSE	0.2199	0.0923	0.0658	0.0891	0.8442	0.1242	0.0726	0.1070	
SD ratio	0.9108	1.1089	0.9279	1.0816	0.5369	1.0234	0.9543	1.0365	

Table A.32: Simulation Result of the SEM approach (A16, B16, C16)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A16)	SEM			size:2000			**110 cases converge**			
mean	0.3133	0.3610	0.5971	0.4143	0.6964	0.4611	0.7978	0.5117	0.5475	0.2010
bias	-0.0133	-0.0110	0.0029	-0.0143	0.0036	-0.0111	0.0022	-0.0117	0.0025	-0.0010
RMSE	0.0783	0.0594	0.0132	0.0644	0.0139	0.0705	0.0137	0.0902	0.0190	0.0132
SD ratio	1.0581	1.0869	1.0484	1.0309	1.0203	1.0192	0.9634	1.0714	0.9809	1.0334
(B16)	SEM			size:500			**109 cases converge**			
mean	0.3292	0.3772	0.5916	0.4272	0.6929	0.4771	0.7948	0.4769	0.5429	0.2017
bias	-0.0292	-0.0272	0.0084	-0.0272	0.0071	-0.0271	0.0052	0.0231	0.0071	-0.0017
RMSE	0.1908	0.1415	0.0332	0.1525	0.0318	0.1692	0.0341	0.2229	0.0419	0.0276
SD ratio	1.1933	1.2459	1.2418	1.1764	1.1218	1.1658	1.1430	1.3044	1.1322	1.1053
(C16)	SEM			size:200			**96 cases converge**			
mean	0.3183	0.3804	0.5913	0.4147	0.6949	0.4694	0.7913	0.4235	0.5453	0.2067
bias	-0.0183	-0.0304	0.0087	-0.0147	0.0051	-0.0194	0.0087	0.0765	0.0047	-0.0067
RMSE	0.2561	0.1664	0.0447	0.1888	0.0461	0.2170	0.0577	0.3352	0.0602	0.0420
SD ratio	1.0496	0.9389	1.0919	0.9533	1.0900	0.9769	1.2439	1.1449	1.0550	1.0862

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	3.00	0.50	5.00	1.00	3.00	0.00
(A16)	SEM			size:2000			**110 cases converge**		
mean	0.5993	0.3023	0.4031	2.9551	0.4600	4.9612	1.0207	2.9795	-0.0265
bias	0.0007	-0.0023	-0.0031	0.0449	0.0400	0.0388	-0.0207	0.0205	0.0265
RMSE	0.0185	0.0173	0.0214	0.1570	0.1779	0.4751	0.0864	0.1102	0.1366
SD ratio	1.0235	1.0531	1.0459	1.0739	1.0603	1.1301	1.0786	1.0815	1.0186
(B16)	SEM			size:500			**109 cases converge**		
mean	0.6021	0.3009	0.4013	2.9453	0.4516	5.0974	1.0589	2.9210	-0.0534
bias	-0.0021	-0.0009	-0.0013	0.0547	0.0484	-0.0974	-0.0589	0.0790	0.0534
RMSE	0.0378	0.0379	0.0498	0.3866	0.4113	1.0772	0.2684	0.3648	0.4028
SD ratio	1.0606	1.1999	1.2686	1.1612	1.1829	1.2292	1.5624	1.3923	1.4294
(C16)	SEM			size:200			**96 cases converge**		
mean	0.6001	0.2992	0.3960	2.9456	0.5698	5.5133	1.0561	2.8968	-0.0488
bias	-0.0001	0.0008	0.0040	0.0544	-0.0698	-0.5133	-0.0562	0.1032	0.0488
RMSE	0.0677	0.0529	0.0647	0.5437	0.5813	1.7841	0.4265	0.5647	0.6332
SD ratio	1.1790	1.1157	1.1078	1.0295	1.0541	1.1349	1.5516	1.2605	1.3874

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A16)	SEM			size:2000			**110 cases converge**		
mean	0.4928	0.5005	0.4993	0.4992	0.5227	0.5029	0.5008	0.4972	*fixed*
bias	0.0072	-0.0005	0.0007	0.0008	-0.0227	-0.0029	-0.0008	0.0028	
RMSE	0.0309	0.0198	0.0187	0.0212	0.2589	0.0227	0.0168	0.0250	
SD ratio	1.0335	1.0682	0.9426	0.9807	1.0968	1.0888	0.8350	0.9910	
(B16)	SEM			size:500			**109 cases converge**		
mean	0.4874	0.4975	0.5064	0.4997	0.3953	0.4963	0.4937	0.4946	*fixed*
bias	0.0126	0.0025	-0.0064	0.0003	0.1047	0.0037	0.0063	0.0054	
RMSE	0.0627	0.0350	0.0383	0.0434	0.6247	0.0438	0.0453	0.0556	
SD ratio	1.0383	0.9400	0.9396	0.9977	1.1655	1.0879	1.1093	1.1137	
(C16)	SEM			size:200			**96 cases converge**		
mean	0.4864	0.4941	0.5035	0.4849	0.1120	0.5132	0.4971	0.4977	*fixed*
bias	0.0136	0.0059	-0.0035	0.0151	0.3880	-0.0132	0.0029	0.0023	
RMSE	0.0922	0.0617	0.0668	0.0730	1.2075	0.0662	0.0683	0.0945	
SD ratio	0.9513	1.0472	1.0511	1.0573	1.1259	1.0037	1.0445	1.2093	

Table A.33: Simulation Result of the Classical approach (A16, B16, C16)

Design	Parameters b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A16)	Classical			size:2000			**90 cases converge**			
mean	0.3663	0.4035	0.5863	0.4662	0.6834	0.5212	0.7822	0.5330	0.5608	0.1979
bias	-0.0663	-0.0535	0.0137	-0.0662	0.0166	-0.0712	0.0178	-0.0330	-0.0108	0.0021
RMSE	0.1667	0.1277	0.0289	0.1537	0.0346	0.1718	0.0354	0.2544	0.0492	0.0159
SD ratio	0.8293	0.7991	0.9045	0.8291	0.9512	0.8272	0.8749	0.7965	0.8465	0.8287
(B16)	Classical			size:500			**61 cases converge**			
mean	0.4121	0.4795	0.5531	0.5324	0.6661	0.5830	0.7507	0.5774	0.6212	0.1746
bias	-0.1121	-0.1295	0.0469	-0.1324	0.0339	-0.1330	0.0493	-0.0774	-0.0712	0.0254
RMSE	0.2993	0.2581	0.1175	0.2809	0.1172	0.3247	0.1397	0.3328	0.2102	0.0903
SD ratio	0.9252	0.8806	1.0414	0.8729	1.1120	0.9297	1.2025	0.7665	1.0172	0.9135
(C16)	Classical			size:200			**47 cases converge**			
mean	0.4932	0.5269	0.5369	0.6185	0.5806	0.6441	0.7355	0.6131	0.6150	0.1775
bias	-0.1932	-0.1769	0.0631	-0.2185	0.1194	-0.1941	0.0645	-0.1131	-0.0650	0.0225
RMSE	0.5305	0.3693	0.2033	0.5058	0.2930	0.4984	0.2673	0.3480	0.2590	0.1176
SD ratio	1.2454	0.8963	0.8335	1.0731	0.9362	0.8774	0.7447	0.8742	0.7843	0.6453

Design	Parameters b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	3.00	0.50	5.00	1.00	3.00	0.00
(A16)	Classical			size:2000			**90 cases converge**		
mean	0.6049	0.3042	0.4106	2.8611	0.3643	4.8825	0.9503	2.8595	-0.1124
bias	-0.0049	-0.0042	-0.0106	0.1389	0.1357	0.1175	0.0497	0.1405	0.1124
RMSE	0.0486	0.0266	0.0390	0.3174	0.3846	1.0807	0.2820	0.2738	0.3159
SD ratio	1.0781	0.8680	0.8323	0.8912	0.8271	0.7819	27.8370	71.0173	92.6817
(B16)	Classical			size:500			**61 cases converge**		
mean	0.5875	0.3153	0.4207	2.8422	0.2500	4.7008	0.8607	2.7346	-0.2001
bias	0.0125	-0.0153	-0.0207	0.1578	0.2500	0.2992	0.1393	0.2654	0.2001
RMSE	0.0952	0.0460	0.0572	0.5862	0.6385	1.3359	0.3796	0.5035	0.4750
SD ratio	1.0654	0.7972	0.8769	0.9109	0.9015	0.6944	10.5631	31.2779	32.9217
(C16)	Classical			size:200			**47 cases converge**		
mean	0.6033	0.2999	0.4370	2.5008	0.1388	4.5842	0.8329	2.3890	-0.3095
bias	-0.0033	0.0001	-0.0370	0.4992	0.3612	0.4158	0.1671	0.6110	0.3095
RMSE	0.2672	0.1300	0.0720	1.1273	0.9332	1.6676	0.6492	0.8424	0.5836
SD ratio	0.7231	0.6122	0.9803	1.2862	1.1181	1.0632	13.3361	21.4785	18.4666

Design	Parameters $\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A16)	Classical			size:2000			**90 cases converge**		
mean	0.4811	0.4999	0.4983	0.4989	0.7158	0.5002	0.4989	0.4921	*fixed*
bias	0.0189	0.0001	0.0017	0.0011	-0.2158	-0.0002	0.0011	0.0079	
RMSE	0.0418	0.0198	0.0210	0.0219	0.4331	0.0281	0.0213	0.0307	
SD ratio	0.9494	1.0440	1.0241	0.9738	0.4357	1.0895	0.8837	0.9896	
(B16)	Classical			size:500			**61 cases converge**		
mean	0.4334	0.4898	0.4971	0.4981	0.8849	0.4520	0.5009	0.4802	*fixed*
bias	0.0666	0.0102	0.0029	0.0019	-0.3849	0.0480	-0.0009	0.0198	
RMSE	0.1860	0.0407	0.0398	0.0544	0.5309	0.1144	0.0579	0.0609	
SD ratio	1.1169	0.9870	0.9130	1.1459	0.3047	1.0441	1.2444	1.0657	
(C16)	Classical			size:200			**47 cases converge**		
mean	0.4266	0.4679	0.4670	0.4914	0.9823	0.4575	0.4913	0.4566	*fixed*
bias	0.0734	0.0321	0.0330	0.0086	-0.4824	0.0450	0.0087	0.0434	
RMSE	0.1615	0.0747	0.1018	0.0908	0.9252	0.1286	0.0853	0.1281	
SD ratio	0.9988	1.0531	1.1558	1.0587	0.9430	0.8471	0.7700	1.3323	

Table A.34: Simulation Result of the SEM approach (A17, B17, C17)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A17)	SEM			size:2000			**110 cases converge**			
mean	0.3026	0.3536	0.5996	0.3979	0.7012	0.4516	0.8012	0.4951	0.5495	0.2004
bias	-0.0026	-0.0036	0.0004	0.0021	-0.0012	-0.0016	-0.0012	0.0049	0.0005	-0.0004
RMSE	0.0407	0.0347	0.0207	0.0355	0.0241	0.0347	0.0240	0.0658	0.0285	0.0283
SD ratio	1.0209	1.0445	0.9999	0.9926	1.0897	0.8960	0.9750	1.1085	1.0141	1.0534
(B17)	SEM			size:500			**101 cases converge**			
mean	0.2789	0.3415	0.5928	0.3830	0.6958	0.4392	0.7950	0.4640	0.5562	0.1937
bias	0.0211	0.0085	0.0072	0.0170	0.0042	0.0108	0.0050	0.0360	-0.0062	0.0063
RMSE	0.0760	0.0664	0.0444	0.0744	0.0492	0.0815	0.0514	0.1146	0.0564	0.0554
SD ratio	0.9361	0.9917	1.0832	1.0086	1.1505	1.0367	1.0669	0.9389	1.0125	1.0576
(C17)	SEM			size:200			**82 cases converge**			
mean	0.2724	0.3433	0.5765	0.3788	0.6825	0.4332	0.7794	0.4130	0.5405	0.1764
bias	0.0276	0.0067	0.0235	0.0212	0.0175	0.0169	0.0206	0.0870	0.0095	0.0236
RMSE	0.1259	0.1067	0.0735	0.1422	0.0847	0.1255	0.0936	0.2605	0.1056	0.0937
SD ratio	0.9963	1.0294	1.1233	1.2403	1.2147	1.0073	1.2262	1.3518	1.2592	1.1685

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.50	1.00	1.00	3.00	5.00
(A17)	SEM			size:2000			**110 cases converge**		
mean	0.5990	0.3007	0.4013	0.9909	0.4961	1.0161	0.9690	3.0063	5.0216
bias	0.0010	-0.0007	-0.0013	0.0091	0.0039	-0.0161	0.0310	-0.0063	-0.0216
RMSE	0.0306	0.0278	0.0256	0.0742	0.0931	0.2157	0.2810	0.0961	0.1450
SD ratio	1.0599	1.0288	1.0366	1.1087	1.1148	1.1090	1.0343	0.9634	0.9757
(B17)	SEM			size:500			**101 cases converge**		
mean	0.6051	0.2935	0.3961	1.0315	0.5414	1.0890	0.9698	3.0277	5.0651
bias	-0.0051	0.0065	0.0039	-0.0315	-0.0414	-0.0890	0.0302	-0.0277	-0.0652
RMSE	0.0525	0.0549	0.0498	0.1197	0.1575	0.3680	0.5846	0.1952	0.3168
SD ratio	0.9130	1.0307	1.0382	0.9142	0.9690	0.9586	1.0628	0.9779	0.9939
(C17)	SEM			size:200			**82 cases converge**		
mean	0.6064	0.2689	0.3794	1.0639	0.5889	1.3260	1.0538	3.0221	5.0641
bias	-0.0064	0.0311	0.0206	-0.0639	-0.0889	-0.3260	-0.0538	-0.0221	-0.0641
RMSE	0.1124	0.1027	0.0817	0.2092	0.3096	0.8116	0.8993	0.3230	0.6153
SD ratio	1.2543	1.1550	1.0930	0.9774	1.2262	1.2687	0.9471	0.8085	0.9610

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A17)	SEM			size:2000			**110 cases converge**		
mean	0.5008	0.4978	0.5000	0.5002	0.4869	0.5015	0.5006	0.4999	*fixed*
bias	-0.0008	0.0022	0.0000	-0.0002	0.0131	-0.0015	-0.0006	0.0001	
RMSE	0.0274	0.0214	0.0220	0.0202	0.0985	0.0217	0.0201	0.0250	
SD ratio	1.0442	1.1765	1.1447	0.9775	1.0882	1.1041	1.0064	1.1753	
(B17)	SEM			size:500			**101 cases converge**		
mean	0.4865	0.5061	0.4974	0.5014	0.4415	0.4945	0.4932	0.5036	*fixed*
bias	0.0135	-0.0061	0.0026	-0.0014	0.0585	0.0055	0.0068	-0.0036	
RMSE	0.0550	0.0412	0.0360	0.0382	0.1861	0.0384	0.0400	0.0401	
SD ratio	1.0195	1.1118	0.9392	0.9201	0.9867	0.9696	0.9861	0.9331	
(C17)	SEM			size:200			**82 cases converge**		
mean	0.4676	0.4914	0.5019	0.5130	0.2467	0.4954	0.4928	0.4962	*fixed*
bias	0.0324	0.0086	-0.0019	-0.0130	0.2533	0.0046	0.0072	0.0038	
RMSE	0.1027	0.0495	0.0658	0.0712	0.4951	0.0604	0.0618	0.0826	
SD ratio	1.1549	0.8610	1.0732	1.0508	1.3541	0.9821	0.9554	1.2070	

Table A.35: Simulation Result of the Classical approach (A17, B17, C17)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A17)	Classical			size:2000			**63 cases converge**			
mean	0.3089	0.4947	0.5734	0.5334	0.6727	0.6264	0.7735	0.5673	0.6407	0.0651
bias	-0.0089	-0.1447	0.0266	-0.1334	0.0273	-0.1764	0.0265	-0.0673	-0.0907	0.1349
RMSE	0.0783	0.4008	0.0967	0.4081	0.0813	0.5453	0.0918	0.1404	0.2080	0.3680
SD ratio	0.8921	1.0368	0.9506	1.0017	0.8117	1.0373	0.7157	0.4720	0.7213	0.7795
(B17)	Classical			size:500			**36 cases converge**			
mean	0.2534	0.4101	0.6472	0.3940	0.7719	0.4642	0.9049	0.5580	0.6784	-0.1331
bias	0.0466	-0.0601	-0.0472	0.0061	-0.0719	-0.0142	-0.1049	-0.0580	-0.1284	0.3331
RMSE	0.1344	0.3140	0.2256	0.4147	0.2909	0.4689	0.3463	0.1719	0.3689	0.9641
SD ratio	0.8334	0.4225	0.4127	0.4275	0.4109	0.4353	0.4315	0.6603	0.3883	0.3987
(C17)	Classical			size:200			**31 cases converge**			
mean	0.2303	0.2708	0.5923	0.4196	0.7319	0.5254	1.0144	0.4850	0.5520	0.1487
bias	0.0697	0.0792	0.0077	-0.0196	-0.0319	-0.0754	-0.2144	0.0150	-0.0020	0.0513
RMSE	0.2269	0.2638	0.1696	0.3041	0.1981	0.5407	1.1920	0.1995	0.2985	0.4232
SD ratio	1.1352	1.0277	0.8032	0.9838	0.7151	0.8440	1.1744	0.9562	1.0532	0.9160

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.50	1.00	1.00	3.00	5.00
(A17)	Classical			size:2000			**63 cases converge**		
mean	0.6095	0.2820	0.4510	1.0165	0.4309	0.7846	3.7842	3.6049	4.4497
bias	-0.0095	0.0180	-0.0510	-0.0165	0.0691	0.2154	-2.7842	-0.6049	0.5503
RMSE	0.1735	0.2657	0.0861	0.1927	0.1740	0.4709	3.3872	0.9024	0.8859
SD ratio	0.9984	0.8450	0.6893	0.8904	0.5825	0.5571	30.3627	24.5475	36.1522
(B17)	Classical			size:500			**36 cases converge**		
mean	0.6717	0.1397	0.4640	1.1135	0.5190	0.7848	3.6645	3.5718	4.5308
bias	-0.0717	0.1603	-0.0640	-0.1135	-0.0190	0.2152	-2.6645	-0.5718	0.4692
RMSE	0.3181	0.6958	0.1113	0.3675	0.2289	0.5374	3.3077	0.9009	0.8509
SD ratio	1.7971	2.1713	0.9107	0.4226	0.7296	0.6139	15.9091	9.3592	13.2748
(C17)	Classical			size:200			**31 cases converge**		
mean	0.5247	0.4002	0.4202	1.1067	0.5716	0.9174	4.4319	4.3516	4.8542
bias	0.0753	-0.1002	-0.0202	-0.1068	-0.0716	0.0826	-3.4319	-1.3516	0.1458
RMSE	0.3648	0.4123	0.1192	0.3664	0.3170	0.4676	3.8094	1.8147	1.0897
SD ratio	0.9392	0.8244	1.0797	1.0652	1.0152	0.7825	8.9095	9.3984	9.8873

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A17)	Classical			size:2000			**63 cases converge**		
mean	0.4640	0.4935	0.5006	0.4939	0.5705	0.4872	0.5002	0.4908	*fixed*
bias	0.0360	0.0065	-0.0006	0.0061	-0.0705	0.0128	-0.0002	0.0092	
RMSE	0.1365	0.0236	0.0255	0.0236	0.1784	0.0398	0.0270	0.0310	
SD ratio	1.1162	1.1054	1.1786	0.9232	0.5318	0.9260	1.1096	1.0541	
(B17)	Classical			size:500			**36 cases converge**		
mean	0.4443	0.4964	0.4718	0.4756	0.5743	0.4890	0.4713	0.4726	*fixed*
bias	0.0557	0.0036	0.0282	0.0244	-0.0743	0.0110	0.0287	0.0274	
RMSE	0.2631	0.0406	0.0460	0.0817	0.2225	0.0610	0.0854	0.0602	
SD ratio	0.3828	0.9141	0.7689	0.8293	0.5058	0.8173	1.1416	0.9735	
(C17)	Classical			size:200			**31 cases converge**		
mean	0.4309	0.4491	0.4749	0.4936	0.5625	0.4549	0.4514	0.4677	*fixed*
bias	0.0691	0.0509	0.0251	0.0064	-0.0625	0.0451	0.0486	0.0323	
RMSE	0.1867	0.0886	0.0977	0.0759	0.1844	0.1147	0.1369	0.1136	
SD ratio	1.2018	0.9628	1.0113	0.4813	0.6063	0.9839	0.8359	1.2474	

Table A.36: Simulation Result of the SEM approach (A18, B18, C18)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A18)	SEM			size:2000				**109 cases converge**		
mean	0.2988	0.3529	0.5975	0.4015	0.6981	0.4519	0.7974	0.4955	0.5467	0.2067
bias	0.0012	-0.0029	0.0025	-0.0015	0.0019	-0.0019	0.0026	0.0045	0.0033	-0.0067
RMSE	0.0469	0.0345	0.0133	0.0389	0.0146	0.0416	0.0149	0.0850	0.0207	0.0336
SD ratio	1.1147	1.0133	0.9967	1.0515	1.0439	1.0361	0.9968	1.1945	0.9815	0.9532
(B18)	SEM			size:500				**100 cases converge**		
mean	0.2780	0.3484	0.5944	0.3993	0.6925	0.4410	0.7970	0.4480	0.5486	0.2031
bias	0.0220	0.0016	0.0056	0.0007	0.0075	0.0090	0.0030	0.0520	0.0014	-0.0031
RMSE	0.0886	0.0684	0.0261	0.0782	0.0293	0.0824	0.0283	0.1648	0.0368	0.0613
SD ratio	1.0408	1.0158	0.9743	1.0690	1.0152	1.0298	0.9603	1.1159	0.9332	0.9634
(C18)	SEM			size:200				**82 cases converge**		
mean	0.2920	0.3457	0.6003	0.4075	0.6939	0.4405	0.7998	0.3595	0.5574	0.1711
bias	0.0080	0.0043	-0.0003	-0.0075	0.0061	0.0095	0.0002	0.1405	-0.0074	0.0289
RMSE	0.1176	0.1205	0.0476	0.1023	0.0416	0.1321	0.0420	0.3300	0.0700	0.1145
SD ratio	0.9686	1.1773	1.1301	0.9211	0.9603	1.1016	0.9256	1.3584	1.0310	1.0325

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.50	1.00	1.00	3.00	0.00
(A18)	SEM			size:2000			**109 cases converge**		
mean	0.5985	0.3063	0.4046	0.9948	0.5010	1.0387	1.0187	2.9961	-0.0143
bias	0.0015	-0.0063	-0.0046	0.0052	-0.0010	-0.0387	-0.0187	0.0039	0.0143
RMSE	0.0184	0.0447	0.0546	0.0757	0.1085	0.3015	0.0905	0.0733	0.1354
SD ratio	0.9287	1.1024	1.2340	1.1131	1.1384	1.1648	1.1271	1.1244	1.1940
(B18)	SEM			size:500			**100 cases converge**		
mean	0.5991	0.2938	0.3846	1.0364	0.5715	1.2492	1.0136	3.0220	0.0253
bias	0.0009	0.0062	0.0154	-0.0364	-0.0715	-0.2492	-0.0136	-0.0220	-0.0253
RMSE	0.0424	0.0732	0.0743	0.1348	0.2174	0.6821	0.1932	0.1535	0.2556
SD ratio	1.0761	1.0034	0.9235	0.9645	1.1185	1.1914	1.3542	1.1927	1.2063
(C18)	SEM			size:200			**82 cases converge**		
mean	0.6183	0.2491	0.3763	0.9847	0.6181	1.7043	0.9573	3.0177	0.1198
bias	-0.0183	0.0509	0.0237	0.0153	-0.1181	-0.7043	0.0427	-0.0177	-0.1198
RMSE	0.0749	0.1229	0.1362	0.1799	0.3247	1.5203	0.2163	0.1863	0.3419
SD ratio	1.0383	0.9741	1.1995	0.8998	1.0999	1.2915	1.0444	0.9776	1.0856

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A18)	SEM			size:2000			**109 cases converge**		
mean	0.4980	0.4973	0.5006	0.5005	0.4726	0.4993	0.5004	0.4977	*fixed*
bias	0.0020	0.0027	-0.0006	-0.0005	0.0274	0.0007	-0.0004	0.0023	
RMSE	0.0236	0.0162	0.0207	0.0188	0.1457	0.0204	0.0194	0.0224	
SD ratio	0.9594	0.8851	1.0818	0.9175	1.1154	1.0627	0.9953	1.0381	
(B18)	SEM			size:500			**100 cases converge**		
mean	0.4934	0.4951	0.4994	0.4992	0.3471	0.4904	0.4993	0.5037	*fixed*
bias	0.0066	0.0049	0.0006	0.0008	0.1529	0.0096	0.0007	-0.0037	
RMSE	0.0562	0.0361	0.0377	0.0401	0.4023	0.0406	0.0385	0.0430	
SD ratio	1.1247	0.9938	0.9843	0.9755	1.2214	1.0419	0.9773	0.9971	
(C18)	SEM			size:200			**82 cases converge**		
mean	0.4894	0.4952	0.4879	0.4988	-0.0474	0.4959	0.4858	0.5041	*fixed*
bias	0.0106	0.0048	0.0121	0.0012	0.5474	0.0041	0.0142	-0.0041	
RMSE	0.0802	0.0558	0.0584	0.0725	1.1332	0.0624	0.0690	0.0686	
SD ratio	1.0376	0.9704	0.9578	1.1188	1.2617	1.0233	1.0779	0.9968	

Table A.37: Simulation Result of the Classical approach (A18, B18, C18)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A18)	Classical			size:2000			**45 cases converge**			
mean	0.3055	0.4421	0.5993	0.5153	0.6837	0.5456	0.7687	0.6072	0.6141	0.1047
bias	-0.0055	-0.0921	0.0007	-0.1153	0.0163	-0.0956	0.0313	-0.1072	-0.0641	0.0953
RMSE	0.0776	0.1779	0.0698	0.2272	0.0785	0.2482	0.0947	0.1343	0.1759	0.2527
SD ratio	1.0283	0.8946	0.9611	1.0486	0.9980	1.1722	1.1109	0.6503	0.9796	0.8842
(B18)	Classical			size:500			**38 cases converge**			
mean	0.2536	0.5825	0.6721	0.4695	0.8366	0.5547	0.8707	0.5492	0.7377	-0.1121
bias	0.0464	-0.2325	-0.0721	-0.0695	-0.1366	-0.1047	-0.0707	-0.0492	-0.1877	0.3121
RMSE	0.1455	0.7640	0.3555	0.8483	0.4368	0.5605	0.2694	0.1658	0.7623	1.0329
SD ratio	0.9598	0.4519	0.4148	0.3974	0.3914	0.4052	0.3437	0.6702	0.4201	0.4185
(C18)	Classical			size:200			**43 cases converge**			
mean	0.2190	0.3991	1.0955	0.4519	0.6685	0.5074	0.7796	0.4538	0.4941	0.1776
bias	0.0810	-0.0491	-0.4955	-0.0519	0.0315	-0.0574	0.0204	0.0462	0.0559	0.0224
RMSE	0.2463	1.5941	1.7926	0.6133	0.4196	0.5964	0.4261	0.2956	0.4651	0.7095
SD ratio	1.0316	0.4673	0.4124	0.4241	0.3671	0.3977	0.3826	1.1135	0.6471	0.9481

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.50	1.00	1.00	3.00	0.00
(A18)	Classical			size:2000			**45 cases converge**		
mean	0.6283	0.2840	0.4670	1.0167	0.4119	0.6542	0.7625	2.9467	-0.0121
bias	-0.0283	0.0160	-0.0670	-0.0167	0.0881	0.3458	0.2375	0.0533	0.0121
RMSE	0.1576	0.2153	0.0875	0.1499	0.1672	0.4290	0.6116	0.2195	0.1786
SD ratio	1.0191	0.9456	0.8070	0.9850	0.8962	0.6401	31.6872	27.5757	33.4622
(B18)	Classical			size:500			**38 cases converge**		
mean	0.6679	0.1415	0.4581	1.0685	0.4961	0.7971	0.4309	2.7774	0.0855
bias	-0.0679	0.1585	-0.0581	-0.0685	0.0039	0.2029	0.5691	0.2226	-0.0855
RMSE	0.4185	0.8793	0.0950	0.2539	0.2252	0.5565	1.0632	0.4475	0.2741
SD ratio	0.5498	0.6338	0.7317	0.9362	0.7475	0.6580	19.1203	13.2986	11.1452
(C18)	Classical			size:200			**43 cases converge**		
mean	0.6177	0.1387	0.4577	1.0889	0.5582	0.9109	0.3784	2.7310	0.1319
bias	-0.0177	0.1613	-0.0577	-0.0889	-0.0582	0.0891	0.6216	0.2690	-0.1319
RMSE	0.4598	0.7433	0.1139	0.3804	0.3504	0.5707	1.4180	0.7839	0.6727
SD ratio	0.5486	0.6481	0.7315	0.8850	1.0765	0.8417	14.0463	10.4917	10.7879

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A18)	Classical			size:2000			**45 cases converge**		
mean	0.4679	0.4869	0.4961	0.5012	0.6265	0.4916	0.4925	0.4820	*fixed*
bias	0.0321	0.0131	0.0039	-0.0012	-0.1265	0.0084	0.0075	0.0180	
RMSE	0.0810	0.0226	0.0258	0.0230	0.1623	0.0366	0.0338	0.0306	
SD ratio	1.0833	0.8371	1.1059	0.9392	0.6745	1.0942	1.0864	0.9407	
(B18)	Classical			size:500			**38 cases converge**		
mean	0.4882	0.4492	0.4798	0.4670	0.5915	0.4679	0.4824	0.4735	*fixed*
bias	0.0118	0.0508	0.0202	0.0330	-0.0915	0.0321	0.0176	0.0265	
RMSE	0.1242	0.1120	0.0911	0.0761	0.2122	0.1016	0.0580	0.0587	
SD ratio	1.1579	0.9261	0.3439	1.1225	0.4558	0.3209	1.0623	0.9884	
(C18)	Classical			size:200			**43 cases converge**		
mean	0.4682	0.4502	0.4184	0.4640	0.5523	0.4728	0.4743	0.4372	*fixed*
bias	0.0318	0.0498	0.0816	0.0360	-0.0523	0.0272	0.0257	0.0628	
RMSE	0.1468	0.1376	0.1379	0.1031	0.2052	0.1196	0.1560	0.1400	
SD ratio	0.7102	0.5350	0.6707	1.1736	0.5447	1.0711	1.1719	0.8406	

Table A.38: Simulation Result of the SEM approach (A19, B19, C19)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A19)	SEM			size:2000			**110 cases converge**			
mean	0.3011	0.3504	0.6002	0.3983	0.7014	0.4464	0.8011	0.4894	0.5508	0.1992
bias	-0.0011	-0.0004	-0.0002	0.0017	-0.0014	0.0036	-0.0011	0.0106	-0.0008	0.0008
RMSE	0.0430	0.0354	0.0190	0.0400	0.0213	0.0436	0.0227	0.0607	0.0284	0.0256
SD ratio	1.0935	1.0675	0.9280	1.1133	0.9572	1.1215	0.9448	1.0113	1.0013	0.9656
(B19)	SEM			size:500			**101 cases converge**			
mean	0.2993	0.3563	0.5917	0.4024	0.6956	0.4573	0.7953	0.4802	0.5532	0.1955
bias	0.0007	-0.0063	0.0083	-0.0024	0.0044	-0.0073	0.0047	0.0198	-0.0032	0.0045
RMSE	0.0895	0.0743	0.0433	0.0804	0.0420	0.0843	0.0478	0.1106	0.0512	0.0491
SD ratio	1.1314	1.1072	1.0375	1.1091	0.9442	1.0673	0.9659	0.9534	0.9253	0.9617
(C19)	SEM			size:200			**90 cases converge**			
mean	0.2960	0.3605	0.5926	0.4080	0.6851	0.4700	0.7798	0.4637	0.5634	0.1791
bias	0.0040	-0.0105	0.0074	-0.0080	0.0149	-0.0200	0.0202	0.0363	-0.0134	0.0209
RMSE	0.1124	0.1157	0.0782	0.1150	0.0859	0.1388	0.1144	0.1838	0.1048	0.1014
SD ratio	0.8796	1.0638	1.0863	0.9824	1.1529	1.0786	1.3697	1.0523	1.2409	1.2281

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.50	1.00	1.00	3.00	5.00
(A19)	SEM			size:2000			**110 cases converge**		
mean	0.5973	0.2990	0.3988	1.0042	0.5179	1.0522	0.9956	3.0008	5.0174
bias	0.0027	0.0010	0.0012	-0.0042	-0.0179	-0.0522	0.0045	-0.0008	-0.0174
RMSE	0.0279	0.0251	0.0240	0.0656	0.0812	0.1919	0.2511	0.1032	0.1404
SD ratio	0.9518	0.9439	0.9918	1.0081	0.9600	0.9493	0.9689	1.0812	0.9980
(B19)	SEM			size:500			**101 cases converge**		
mean	0.6016	0.2947	0.3970	1.0212	0.5333	1.0985	0.9984	2.9919	5.0309
bias	-0.0016	0.0053	0.0030	-0.0212	-0.0333	-0.0986	0.0016	0.0081	-0.0309
RMSE	0.0615	0.0484	0.0440	0.1489	0.1693	0.3796	0.4779	0.1973	0.2646
SD ratio	1.0800	0.9448	0.9510	1.1240	1.0310	0.9936	0.9248	0.9975	0.8879
(C19)	SEM			size:200			**90 cases converge**		
mean	0.6239	0.2770	0.3885	1.0382	0.5551	1.2126	0.9786	2.9989	5.0903
bias	-0.0239	0.0230	0.0115	-0.0382	-0.0551	-0.2126	0.0214	0.0011	-0.0903
RMSE	0.1041	0.1007	0.0830	0.2103	0.2817	0.6910	1.0554	0.3749	0.6171
SD ratio	1.1509	1.1958	1.1692	0.9578	1.1412	1.2199	1.0148	0.9064	0.8597

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A19)	SEM			size:2000			**110 cases converge**		
mean	0.4999	0.4968	0.5033	0.5005	0.4751	0.4983	0.5005	0.4991	*fixed*
bias	0.0001	0.0032	-0.0033	-0.0006	0.0249	0.0017	-0.0005	0.0009	
RMSE	0.0225	0.0178	0.0200	0.0206	0.0893	0.0211	0.0201	0.0189	
SD ratio	0.8600	0.9713	1.0188	0.9987	0.9377	1.0745	1.0065	0.8869	
(B19)	SEM			size:500			**101 cases converge**		
mean	0.4877	0.5058	0.5001	0.5043	0.4355	0.4940	0.4999	0.4980	*fixed*
bias	0.0123	-0.0058	-0.0001	-0.0043	0.0645	0.0060	0.0001	0.0020	
RMSE	0.0534	0.0368	0.0403	0.0375	0.1944	0.0389	0.0432	0.0414	
SD ratio	0.9869	0.9915	1.0464	0.8947	1.0527	0.9865	1.0792	0.9784	
(C19)	SEM			size:200			**90 cases converge**		
mean	0.4905	0.4834	0.4939	0.4904	0.3423	0.4942	0.4910	0.4952	*fixed*
bias	0.0095	0.0166	0.0061	0.0096	0.1577	0.0058	0.0090	0.0048	
RMSE	0.0902	0.0544	0.0499	0.0651	0.3758	0.0650	0.0670	0.0722	
SD ratio	1.0160	0.9181	0.8205	0.9897	1.2891	1.0509	1.0363	1.0922	

Table A.39: Simulation Result of the Classical approach (A19, B19, C19)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A19)	Classical			size:2000				**48 cases converge**		
mean	0.3050	0.4402	0.5948	0.6184	0.8010	0.6421	0.8309	0.5905	0.8094	-0.2511
bias	-0.0050	-0.0902	0.0052	-0.2184	-0.1010	-0.1921	-0.0309	-0.0905	-0.2594	0.4511
RMSE	0.0706	0.4253	0.0786	0.9262	0.4204	0.5442	0.1812	0.1597	1.1801	1.8419
SD ratio	0.8161	0.6198	0.4396	0.4558	0.5289	0.5524	0.7172	0.5795	0.5207	1.5270
(B19)	Classical			size:500				**48 cases converge**		
mean	0.2241	0.3461	0.6173	0.4381	0.7959	0.5125	0.8592	0.5204	0.5567	0.1477
bias	0.0759	0.0039	-0.0173	-0.0381	-0.0959	-0.0625	-0.0592	-0.0204	-0.0067	0.0523
RMSE	0.1754	0.3163	0.1325	0.4455	0.5494	0.4835	0.5919	0.1687	0.2315	0.4026
SD ratio	1.0331	0.8859	0.7547	0.6654	0.8166	0.7169	0.6401	0.6348	0.8085	0.8023
(C19)	Classical			size:200				**32 cases converge**		
mean	0.2240	0.3447	0.6769	0.4084	0.7201	0.3480	0.8164	0.4962	0.5812	0.1076
bias	0.0760	0.0053	-0.0769	-0.0084	-0.0201	0.1020	-0.0164	0.0038	-0.0312	0.0924
RMSE	0.1895	0.2661	0.2639	0.4172	0.3629	0.3452	0.2905	0.1960	0.2514	0.4655
SD ratio	0.8792	0.8339	0.7778	0.9887	0.8374	1.0439	1.0505	0.7697	0.8607	0.7879

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.50	1.00	1.00	3.00	5.00
(A19)	Classical			size:2000			**48 cases converge**		
mean	0.6526	0.1937	0.4610	1.0218	0.4223	0.7371	3.8066	3.5059	4.1815
bias	-0.0526	0.1063	-0.0610	-0.0218	0.0777	0.2629	-2.8066	-0.5059	0.8185
RMSE	0.2305	0.5126	0.1080	0.1832	0.1712	0.5354	3.5691	1.1396	1.2905
SD ratio	0.5198	0.9446	0.9485	0.7769	0.5972	0.5778	37.0833	34.9771	53.6210
(B19)	Classical			size:500			**48 cases converge**		
mean	0.5494	0.3393	0.4622	1.1344	0.5642	0.8784	4.5407	4.4321	4.8579
bias	0.0506	-0.0393	-0.0622	-0.1344	-0.0642	0.1217	-3.5407	-1.4321	0.1421
RMSE	0.1994	0.2775	0.0987	0.2594	0.2489	0.5425	3.9766	1.8978	0.9540
SD ratio	0.9115	0.7883	0.7247	0.8913	0.7674	0.7622	15.2684	16.6814	15.9492
(C19)	Classical			size:200			**32 cases converge**		
mean	0.6099	0.2483	0.4246	1.1298	0.5481	0.9593	4.8432	4.3598	4.9567
bias	-0.0099	0.0517	-0.0246	-0.1298	-0.0481	0.0407	-3.8432	-1.3598	0.0433
RMSE	0.2844	0.3638	0.1006	0.3496	0.2516	0.5587	4.4865	2.0585	1.0075
SD ratio	1.1056	0.7912	0.7985	0.8835	0.6933	0.6187	11.3647	11.3887	9.3365

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A19)	Classical			size:2000			**48 cases converge**		
mean	0.4702	0.4931	0.4745	0.4921	0.5666	0.4857	0.5012	0.4893	*fixed*
bias	0.0298	0.0069	0.0255	0.0079	-0.0666	0.0143	-0.0012	0.0107	
RMSE	0.1276	0.0211	0.0853	0.0418	0.2093	0.0463	0.0204	0.0324	
SD ratio	0.9241	0.9695	0.6603	1.2343	0.4926	0.2238	0.8804	1.1325	
(B19)	Classical			size:500			**48 cases converge**		
mean	0.4673	0.4888	0.4804	0.4856	0.6198	0.4850	0.4892	0.4620	*fixed*
bias	0.0327	0.0112	0.0196	0.0144	-0.1198	0.0150	0.0108	0.0380	
RMSE	0.0977	0.0526	0.0683	0.0549	0.2107	0.0468	0.0604	0.0694	
SD ratio	1.0443	0.8972	0.3093	0.2129	0.2478	0.9422	1.2222	0.8859	
(C19)	Classical			size:200			**32 cases converge**		
mean	0.4438	0.4581	0.4643	0.4429	0.5706	0.4530	0.4547	0.4482	*fixed*
bias	0.0562	0.0419	0.0357	0.0571	-0.0706	0.0470	0.0453	0.0518	
RMSE	0.1522	0.0777	0.0973	0.1247	0.2024	0.0982	0.1214	0.1202	
SD ratio	0.8305	0.7677	0.9690	1.1434	0.3714	0.9829	1.1661	1.3073	

Table A.40: Simulation Result of the SEM approach (A20, B20, C20)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A20)	SEM			size:2000			**110 cases converge**			
mean	0.3023	0.3443	0.6027	0.4000	0.7000	0.4489	0.8000	0.4985	0.5482	0.2052
bias	-0.0023	0.0057	-0.0027	0.0000	0.0000	0.0011	0.0000	0.0015	0.0018	-0.0052
RMSE	0.0380	0.0325	0.0133	0.0342	0.0131	0.0379	0.0149	0.0729	0.0222	0.0348
SD ratio	0.9103	0.9509	1.0197	0.9330	0.9534	0.9537	1.0258	1.0091	1.0725	1.0044
(B20)	SEM			size:500			**94 cases converge**			
mean	0.3045	0.3549	0.5994	0.4058	0.6973	0.4506	0.7971	0.4828	0.5454	0.2012
bias	-0.0045	-0.0049	0.0006	-0.0058	0.0027	-0.0007	0.0029	0.0172	0.0046	-0.0012
RMSE	0.1000	0.0751	0.0253	0.0830	0.0334	0.0828	0.0315	0.1609	0.0428	0.0687
SD ratio	1.1329	1.0665	0.9129	1.0802	1.1183	0.9955	0.9943	1.1642	1.0232	0.9720
(C20)	SEM			size:200			**74 cases converge**			
mean	0.2933	0.3465	0.5949	0.4096	0.6899	0.4547	0.7865	0.3821	0.5525	0.1971
bias	0.0067	0.0035	0.0051	-0.0096	0.0101	-0.0047	0.0135	0.1179	-0.0025	0.0029
RMSE	0.1166	0.1196	0.0759	0.1317	0.0800	0.1398	0.0843	0.2960	0.0751	0.1094
SD ratio	0.8814	1.1226	1.6459	1.1038	1.5475	1.0893	1.5668	1.2759	1.1311	1.0362

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.50	1.00	1.00	3.00	0.00
(A20)	SEM			size:2000			**110 cases converge**		
mean	0.6004	0.3024	0.4057	0.9947	0.4990	1.0229	1.0115	2.9878	-0.0151
bias	-0.0004	-0.0024	-0.0057	0.0053	0.0010	-0.0229	-0.0115	0.0122	0.0151
RMSE	0.0206	0.0433	0.0454	0.0585	0.0985	0.2849	0.0906	0.0575	0.1217
SD ratio	1.0461	1.0845	1.0025	0.8706	1.0257	1.0892	1.1680	0.8854	1.0774
(B20)	SEM			size:500			**94 cases converge**		
mean	0.5993	0.3076	0.3986	1.0037	0.5175	1.0873	1.0380	2.9782	-0.0166
bias	0.0007	-0.0076	0.0014	-0.0037	-0.0175	-0.0873	-0.0380	0.0218	0.0166
RMSE	0.0397	0.0784	0.0839	0.1388	0.2011	0.5984	0.1898	0.1586	0.2532
SD ratio	1.0024	0.9952	1.0057	0.9442	1.0398	1.1676	1.1194	1.0696	1.1021
(C20)	SEM			size:200			**74 cases converge**		
mean	0.6080	0.2776	0.3717	1.0264	0.6045	1.6056	1.0230	2.9858	0.0588
bias	-0.0080	0.0224	0.0283	-0.0264	-0.1045	-0.6056	-0.0230	0.0142	-0.0588
RMSE	0.0651	0.1184	0.1326	0.1879	0.3362	1.3972	0.2788	0.2493	0.4055
SD ratio	0.9829	1.0620	1.1752	0.8056	1.1360	1.2968	1.2825	1.1500	1.2685

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A20)	SEM			size:2000			**110 cases converge**		
mean	0.4998	0.4983	0.4996	0.5002	0.4806	0.4990	0.4996	0.4966	*fixed*
bias	0.0002	0.0017	0.0004	-0.0002	0.0194	0.0010	0.0004	0.0034	
RMSE	0.0234	0.0178	0.0191	0.0202	0.1458	0.0162	0.0187	0.0221	
SD ratio	0.9604	0.9828	0.9962	0.9876	1.1222	0.8400	0.9589	1.0167	
(B20)	SEM			size:500			**94 cases converge**		
mean	0.4987	0.4957	0.5019	0.4992	0.4243	0.4982	0.4980	0.4942	*fixed*
bias	0.0013	0.0043	-0.0019	0.0008	0.0757	0.0018	0.0020	0.0058	
RMSE	0.0508	0.0376	0.0363	0.0424	0.3403	0.0400	0.0392	0.0458	
SD ratio	1.0230	1.0354	0.9408	1.0354	1.2217	1.0399	0.9978	1.0710	
(C20)	SEM			size:200			**74 cases converge**		
mean	0.4780	0.4872	0.4837	0.4950	0.0356	0.4864	0.5046	0.5111	*fixed*
bias	0.0220	0.0128	0.0163	0.0050	0.4644	0.0136	-0.0046	-0.0111	
RMSE	0.0967	0.0652	0.0624	0.0659	1.0387	0.0546	0.0691	0.0784	
SD ratio	0.9975	1.1358	1.0159	1.0174	1.3313	0.8771	1.0807	1.1204	

Table A.41: Simulation Result of the Classical approach (A20, B20, C20)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A20)	Classical			size:2000			**58 cases converge**			
mean	0.3179	0.5676	0.5883	0.5832	0.6887	0.7405	0.8223	0.5877	0.6795	-0.0242
bias	-0.0179	-0.2176	0.0117	-0.1832	0.0113	-0.2905	-0.0223	-0.0877	-0.1295	0.2242
RMSE	0.0722	0.5281	0.1282	0.5466	0.1320	0.8448	0.2828	0.1602	0.2910	0.5728
SD ratio	0.8963	0.5216	0.6162	0.6744	0.6546	0.5336	0.7492	0.7270	0.5033	1.0275
(B20)	Classical			size:500			**36 cases converge**			
mean	0.3203	0.3118	0.5316	0.5407	0.8158	0.7997	0.7240	0.5800	0.5575	0.1334
bias	-0.0203	0.0382	0.0684	-0.1407	-0.1158	-0.3497	0.0760	-0.0800	-0.0075	0.0666
RMSE	0.1509	0.8535	0.5927	0.9589	0.7133	1.1332	0.7338	0.1654	0.2741	0.4213
SD ratio	0.9968	0.4297	0.4119	0.4250	0.4347	0.3836	0.3748	0.6652	0.4270	0.4769
(C20)	Classical			size:200			**33 cases converge**			
mean	0.2782	0.1454	0.6894	0.1482	0.5697	0.2850	0.8318	0.5317	0.4220	0.3604
bias	0.0218	0.2046	-0.0894	0.2518	0.1303	0.1650	-0.0318	-0.0317	0.1280	-0.1604
RMSE	0.2370	1.1109	0.6392	1.5065	0.8724	1.0065	0.5301	0.1829	0.3920	0.6207
SD ratio	1.1612	0.4586	0.4493	0.6218	0.5612	0.4383	0.3902	0.8717	0.5979	0.6013

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.50	1.00	1.00	3.00	0.00
(A20)	Classical			size:2000			**58 cases converge**		
mean	0.7814	-0.0419	0.4570	0.9871	0.4020	0.7238	0.6594	2.8532	-0.0532
bias	-0.1814	0.3419	-0.0570	0.0129	0.0980	0.2762	0.3406	0.1468	0.0532
RMSE	0.7339	1.4906	0.0855	0.1734	0.1879	0.5047	0.7370	0.3052	0.2231
SD ratio	0.5489	0.5400	0.7399	0.9148	0.7819	0.6706	36.9494	34.4863	41.5820
(B20)	Classical			size:500			**36 cases converge**		
mean	0.7421	0.0862	0.4538	0.9932	0.4173	0.7291	0.7760	2.7924	-0.0639
bias	-0.1421	0.2138	-0.0538	0.0068	0.0827	0.2709	0.2240	0.2076	0.0639
RMSE	0.5474	1.0987	0.0989	0.2616	0.2730	0.4932	0.9276	0.3819	0.3075
SD ratio	0.4060	0.4578	0.8048	1.0114	0.8746	0.5966	21.3087	13.1177	14.6518
(C20)	Classical			size:200			**33 cases converge**		
mean	0.5638	0.3369	0.4328	1.1528	0.4857	0.9057	0.7324	2.7670	-0.0309
bias	0.0362	-0.0369	-0.0328	-0.1528	0.0143	0.0943	0.2676	0.2330	0.0309
RMSE	0.3081	0.3948	0.1044	0.4500	0.3484	0.4358	1.0249	0.4558	0.4349
SD ratio	0.6772	0.5740	0.9179	0.8643	1.0747	0.7228	12.6609	6.9834	8.3001

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A20)	Classical			size:2000			**58 cases converge**		
mean	0.4665	0.4940	0.4950	0.4909	0.5835	0.4906	0.4936	0.4908	*fixed*
bias	0.0335	0.0060	0.0050	0.0091	-0.0835	0.0094	0.0064	0.0092	
RMSE	0.1208	0.0268	0.0248	0.0333	0.1843	0.0325	0.0266	0.0280	
SD ratio	1.1593	1.1830	1.0679	1.1155	0.5324	0.9144	0.9618	0.9717	
(B20)	Classical			size:500			**36 cases converge**		
mean	0.4803	0.4638	0.4912	0.4565	0.6008	0.5060	0.4478	0.4828	*fixed*
bias	0.0197	0.0362	0.0088	0.0435	-0.1008	-0.0060	0.0522	0.0172	
RMSE	0.0795	0.0727	0.0538	0.0820	0.2259	0.0479	0.1069	0.0784	
SD ratio	0.8806	1.1624	0.2369	0.9581	0.6091	0.8052	0.9630	1.3354	
(C20)	Classical			size:200			**33 cases converge**		
mean	0.3791	0.4506	0.4580	0.4505	0.5425	0.4896	0.4589	0.4880	*fixed*
bias	0.1209	0.0494	0.0420	0.0495	-0.0425	0.0104	0.0411	0.0120	
RMSE	0.3113	0.0974	0.1235	0.1465	0.2139	0.0742	0.1443	0.1219	
SD ratio	0.9112	1.1062	0.5700	0.9814	0.7747	0.9379	1.4008	1.3097	

Table A.42: Simulation Result of the SEM approach (A21, B21, C21)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A21)	SEM			size:2000			**108 cases converge**			
mean	0.3048	0.3516	0.5996	0.4030	0.6995	0.4525	0.7999	0.5059	0.5547	0.1977
bias	-0.0048	-0.0016	0.0004	-0.0030	0.0005	-0.0025	0.0001	-0.0059	-0.0047	0.0023
RMSE	0.0503	0.0313	0.0185	0.0357	0.0187	0.0383	0.0206	0.0627	0.0284	0.0254
SD ratio	1.0729	0.9707	1.1007	1.0048	1.0161	0.9858	1.0345	1.0847	1.1180	1.1231
(B21)	SEM			size:500			**95 cases converge**			
mean	0.2959	0.3617	0.5933	0.4034	0.6966	0.4508	0.7995	0.4725	0.5604	0.1927
bias	0.0041	-0.0117	0.0067	-0.0034	0.0034	-0.0008	0.0005	0.0275	-0.0104	0.0073
RMSE	0.0949	0.0695	0.0359	0.0690	0.0319	0.0843	0.0369	0.0912	0.0515	0.0402
SD ratio	1.0626	1.0687	1.0484	0.9816	0.8806	1.0963	0.9540	0.7841	1.0066	0.9428
(C21)	SEM			size:200			**80 cases converge**			
mean	0.2355	0.3233	0.5903	0.3749	0.6833	0.3993	0.7922	0.4508	0.5860	0.1651
bias	0.0645	0.0267	0.0097	0.0251	0.0167	0.0507	0.0078	0.0492	-0.0360	0.0349
RMSE	0.1350	0.1030	0.0546	0.1050	0.0641	0.1254	0.0641	0.1573	0.0821	0.0875
SD ratio	0.9439	1.0175	1.0103	0.9419	1.0980	0.9759	1.0709	0.9803	0.9103	1.1928

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.00	1.00	1.00	3.00	5.00
(A21)	SEM			size:2000			**108 cases converge**		
mean	0.5983	0.2997	0.4001	0.9962	-0.0134	0.9780	0.9994	2.9938	5.0006
bias	0.0017	0.0003	-0.0001	0.0038	0.0134	0.0220	0.0006	0.0062	-0.0006
RMSE	0.0268	0.0235	0.0231	0.0964	0.0958	0.2100	0.2324	0.0736	0.1248
SD ratio	1.0587	1.0561	1.1132	1.1056	1.0949	1.0691	1.0721	0.9823	1.0545
(B21)	SEM			size:500			**95 cases converge**		
mean	0.6031	0.2936	0.3948	1.0201	0.0375	1.1185	1.0151	3.0043	5.0224
bias	-0.0031	0.0064	0.0052	-0.0201	-0.0375	-0.1185	-0.0151	-0.0043	-0.0225
RMSE	0.0489	0.0400	0.0349	0.1446	0.1464	0.3386	0.3706	0.1402	0.1911
SD ratio	0.9529	0.9427	0.8925	0.8844	0.8715	0.8465	0.9238	0.9374	0.8519
(C21)	SEM			size:200			**80 cases converge**		
mean	0.6125	0.2709	0.3764	1.1031	0.1239	1.2256	1.1286	3.0279	4.9841
bias	-0.0125	0.0291	0.0236	-0.1031	-0.1239	-0.2256	-0.1286	-0.0279	0.0159
RMSE	0.0934	0.0854	0.0706	0.2106	0.2195	0.5394	0.8177	0.2670	0.4871
SD ratio	1.1071	1.2156	1.2160	0.8702	0.8785	0.9577	1.3061	1.0481	1.2119

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A21)	SEM			size:2000			**108 cases converge**		
mean	0.4978	0.4976	0.4984	0.5035	0.4985	0.4977	0.4980	0.5004	*fixed*
bias	0.0022	0.0024	0.0016	-0.0035	0.0015	0.0023	0.0020	-0.0004	
RMSE	0.0274	0.0157	0.0212	0.0212	0.0980	0.0191	0.0164	0.0207	
SD ratio	1.0316	0.8466	1.0831	0.9816	1.1172	0.9949	0.8417	0.9855	
(B21)	SEM			size:500			**95 cases converge**		
mean	0.4987	0.4995	0.5063	0.4979	0.4317	0.4956	0.4957	0.5024	*fixed*
bias	0.0013	0.0005	-0.0063	0.0021	0.0683	0.0044	0.0043	-0.0024	
RMSE	0.0561	0.0387	0.0374	0.0419	0.1846	0.0336	0.0393	0.0436	
SD ratio	1.0579	1.0529	0.9353	0.9901	0.9641	0.8684	1.0049	1.0312	
(C21)	SEM			size:200			**80 cases converge**		
mean	0.4769	0.4889	0.5003	0.5086	0.3198	0.4816	0.4936	0.5101	*fixed*
bias	0.0231	0.0111	-0.0003	-0.0086	0.1802	0.0184	0.0064	-0.0101	
RMSE	0.0869	0.0611	0.0696	0.0560	0.3235	0.0588	0.0639	0.0723	
SD ratio	1.0205	1.0520	1.1271	0.8223	1.0022	0.9031	1.0147	1.0673	

Table A.43: Simulation Result of the Classical approach (A21, B21, C21)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A21)	Classical			size:2000				**47 cases converge**		
mean	0.3222	0.4804	0.5114	0.4749	0.6657	0.6687	0.6315	0.5285	0.6992	0.0409
bias	-0.0222	-0.1304	0.0886	-0.0749	0.0343	-0.2187	0.1685	-0.0285	-0.1492	0.1591
RMSE	0.0949	0.4754	0.3660	0.6155	0.4754	0.5339	0.3895	0.1298	0.5948	0.6267
SD ratio	1.0026	0.8595	0.8844	0.9131	0.9501	0.8359	0.8275	0.9209	0.7913	0.7760
(B21)	Classical			size:500				**44 cases converge**		
mean	0.3145	0.4361	0.5430	0.4046	0.7229	0.6249	0.6348	0.5299	0.7278	0.0117
bias	-0.0145	-0.0861	0.0570	-0.0046	-0.0229	-0.1749	0.1652	-0.0299	-0.1778	0.1883
RMSE	0.1183	0.4136	0.3210	0.4752	0.3881	0.7764	0.7936	0.1066	0.6303	0.6571
SD ratio	0.8682	0.8829	0.8393	1.0223	1.0181	0.7961	0.8237	0.7032	0.2833	0.2662
(C21)	Classical			size:200				**36 cases converge**		
mean	0.2014	0.3480	0.5380	0.4946	0.5954	0.4132	0.7327	0.3531	0.6777	-0.0527
bias	0.0986	0.0220	0.0620	-0.0946	0.1046	0.0368	0.0673	0.1469	-0.1277	0.2527
RMSE	0.2104	0.5388	0.4298	1.1530	0.8454	0.8282	0.5931	0.3470	0.8970	0.9438
SD ratio	0.9496	0.5875	0.5544	0.5031	0.4795	0.5547	0.5171	0.9295	0.6131	0.5607

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.00	1.00	1.00	3.00	5.00
(A21)	Classical			size:2000				**47 cases converge**	
mean	0.6740	0.2093	0.4282	1.0359	-0.0597	0.8800	5.5219	3.8182	4.5973
bias	-0.0740	0.0907	-0.0282	-0.0359	0.0597	0.1200	-4.5219	-0.8182	0.4027
RMSE	0.4673	0.4997	0.0542	0.4719	0.1839	0.3828	5.0605	1.0843	0.9488
SD ratio	0.7533	0.7168	0.8459	0.2329	1.0457	0.8532	31.1172	19.5228	30.6028
(B21)	Classical			size:500				**44 cases converge**	
mean	0.7056	0.1739	0.4201	1.0072	-0.0258	0.9181	5.5250	3.8620	4.6079
bias	-0.1056	0.1261	-0.0201	-0.0072	0.0258	0.0819	-4.5250	-0.8620	0.3921
RMSE	0.8229	0.8561	0.0741	0.2136	0.1723	0.3084	4.9538	1.3525	0.9174
SD ratio	1.0499	1.0451	0.9588	0.9200	0.7961	0.6514	14.0660	13.1173	13.1256
(C21)	Classical			size:200				**36 cases converge**	
mean	0.6388	0.1977	0.4149	1.1171	0.1806	1.2231	4.7501	4.1438	5.0463
bias	-0.0389	0.1023	-0.0149	-0.1172	-0.1806	-0.2231	-3.7501	-1.1438	-0.0463
RMSE	0.6756	0.5938	0.1262	0.3249	0.3606	0.7812	4.4599	1.9419	1.4268
SD ratio	0.5986	0.6657	0.9926	1.0191	0.9361	0.6377	9.6776	9.2594	9.5241

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A21)	Classical			size:2000				**47 cases converge**	
mean	0.4148	0.4901	0.4906	0.4962	0.5482	0.4748	0.4901	0.4853	*fixed*
bias	0.0852	0.0099	0.0094	0.0038	-0.0482	0.0252	0.0099	0.0147	
RMSE	0.4449	0.0232	0.0308	0.0319	0.1688	0.0688	0.0349	0.0447	
SD ratio	0.2270	0.9311	1.0736	1.1172	0.7635	0.9706	0.9497	1.0795	
(B21)	Classical			size:500				**44 cases converge**	
mean	0.4719	0.4909	0.4722	0.4818	0.5276	0.4878	0.4696	0.4892	*fixed*
bias	0.0281	0.0091	0.0279	0.0182	-0.0276	0.0122	0.0304	0.0108	
RMSE	0.1031	0.0561	0.0687	0.0866	0.1649	0.0729	0.1278	0.0442	
SD ratio	0.9848	1.0136	0.8986	0.5528	0.7646	0.9820	1.0704	0.8260	
(C21)	Classical			size:200				**36 cases converge**	
mean	0.4685	0.4754	0.4505	0.5047	0.5466	0.4606	0.4661	0.4480	*fixed*
bias	0.0315	0.0246	0.0495	-0.0047	-0.0466	0.0394	0.0339	0.0520	
RMSE	0.1468	0.0673	0.1269	0.0743	0.2105	0.1253	0.1054	0.1377	
SD ratio	1.1082	0.8194	0.7379	0.9423	0.2644	1.1259	0.8624	1.0656	

Table A.44: Simulation Result of the SEM approach (A22, B22, C22)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A22)	SEM			size:2000			**100 cases converge**			
mean	0.3025	0.3571	0.5974	0.4052	0.6964	0.4559	0.7972	0.5014	0.5481	0.1995
bias	-0.0025	-0.0071	0.0026	-0.0052	0.0036	-0.0059	0.0028	-0.0014	0.0019	0.0005
RMSE	0.0601	0.0387	0.0112	0.0448	0.0137	0.0563	0.0146	0.0677	0.0198	0.0352
SD ratio	0.9711	0.9110	0.9439	0.9518	1.0764	1.0710	1.1090	0.9796	0.9773	1.0459
(B22)	SEM			size:500			**78 cases converge**			
mean	0.2675	0.3288	0.6020	0.3791	0.6997	0.4254	0.8019	0.4374	0.5616	0.1722
bias	0.0325	0.0212	-0.0020	0.0209	0.0003	0.0246	-0.0019	0.0626	-0.0116	0.0278
RMSE	0.0811	0.0616	0.0195	0.0766	0.0269	0.0770	0.0248	0.1714	0.0372	0.0713
SD ratio	0.7125	0.7675	0.8782	0.8801	1.1428	0.7811	0.9964	1.2006	0.8575	1.0468
(C22)	SEM			size:200			**67 cases converge**			
mean	0.2270	0.3154	0.5982	0.3655	0.6907	0.4034	0.7986	0.3594	0.5626	0.1488
bias	0.0730	0.0346	0.0018	0.0345	0.0093	0.0466	0.0014	0.1406	-0.0126	0.0512
RMSE	0.1433	0.1156	0.0370	0.1377	0.0410	0.1480	0.0387	0.2746	0.0654	0.0978
SD ratio	0.8843	1.0232	1.0857	1.1205	1.1098	1.0661	1.0151	1.1855	1.0527	0.9764

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.00	1.00	1.00	3.00	0.00
(A22)	SEM			size:2000			**100 cases converge**		
mean	0.6002	0.2956	0.4022	0.9891	-0.0073	1.0023	1.0126	2.9914	-0.0143
bias	-0.0002	0.0044	-0.0022	0.0109	0.0073	-0.0023	-0.0126	0.0086	0.0143
RMSE	0.0197	0.0405	0.0450	0.0941	0.1045	0.2571	0.0750	0.0805	0.1041
SD ratio	1.0433	1.0221	0.9827	0.9233	0.9274	0.9921	1.0084	0.9395	0.9646
(B22)	SEM			size:500			**78 cases converge**		
mean	0.6031	0.2750	0.3804	1.0468	0.0859	1.2949	0.9735	3.0398	0.0586
bias	-0.0031	0.0250	0.0196	-0.0468	-0.0859	-0.2949	0.0265	-0.0398	-0.0586
RMSE	0.0376	0.0748	0.0824	0.1420	0.2130	0.7699	0.1109	0.1041	0.1984
SD ratio	0.9633	0.9728	0.9752	0.8259	1.0271	1.2887	0.8765	0.6941	1.0212
(C22)	SEM			size:200			**67 cases converge**		
mean	0.6120	0.2391	0.3380	1.0904	0.1457	1.8293	0.9658	3.0865	0.1749
bias	-0.0120	0.0609	0.0620	-0.0904	-0.1457	-0.8294	0.0342	-0.0865	-0.1749
RMSE	0.0673	0.1108	0.1317	0.2291	0.2935	1.4793	0.1308	0.1895	0.3211
SD ratio	1.0800	0.9769	1.0702	0.9823	1.0486	1.0876	0.8298	0.9245	1.0610

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A22)	SEM			size:2000			**100 cases converge**		
mean	0.4984	0.4991	0.4966	0.4976	0.4842	0.4996	0.5022	0.4992	*fixed*
bias	0.0016	0.0009	0.0034	0.0024	0.0158	0.0004	-0.0022	0.0008	
RMSE	0.0251	0.0167	0.0183	0.0211	0.1373	0.0204	0.0188	0.0244	
SD ratio	1.0148	0.9121	0.9340	1.0065	1.0298	1.0612	0.9639	1.0513	
(B22)	SEM			size:500			**78 cases converge**		
mean	0.4986	0.4935	0.4933	0.5011	0.2973	0.4957	0.4899	0.5031	*fixed*
bias	0.0014	0.0065	0.0067	-0.0011	0.2027	0.0043	0.0101	-0.0031	
RMSE	0.0482	0.0377	0.0374	0.0407	0.4988	0.0390	0.0368	0.0482	
SD ratio	0.9845	1.0273	0.9597	0.9730	1.3500	0.9906	0.9150	1.0318	
(C22)	SEM			size:200			**67 cases converge**		
mean	0.4690	0.4958	0.4977	0.5101	-0.1325	0.4923	0.4831	0.5168	*fixed*
bias	0.0310	0.0042	0.0023	-0.0101	0.6325	0.0077	0.0169	-0.0168	
RMSE	0.0901	0.0661	0.0659	0.0704	1.2187	0.0548	0.0618	0.0766	
SD ratio	1.1197	1.1493	1.0781	1.0422	1.1990	0.8918	0.9615	1.0043	

Table A.45: Simulation Result of the Classical approach (A22, B22, C22)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A22)	Classical			size:2000			**51 cases converge**			
mean	0.3185	0.6423	0.3715	0.7433	0.4270	0.7713	0.5295	0.5588	0.6570	0.0689
bias	-0.0185	-0.2923	0.2285	-0.3433	0.2730	-0.3213	0.2705	-0.0588	-0.1070	0.1311
RMSE	0.0781	0.7047	0.5544	1.1380	0.9270	1.1008	0.9029	0.0913	0.6983	0.8144
SD ratio	0.9402	0.5597	0.5523	0.5575	0.5587	0.5272	0.5281	0.8613	0.5159	0.5171
(B22)	Classical			size:500			**41 cases converge**			
mean	0.2801	0.3411	0.5923	0.1351	0.8252	0.4107	0.7989	0.4741	0.6902	-0.0023
bias	0.0199	0.0089	0.0077	0.2649	-0.1252	0.0393	0.0011	0.0259	-0.1402	0.2023
RMSE	0.1275	0.4694	0.4019	2.2781	1.4239	0.5407	0.3702	0.1963	0.6027	0.8053
SD ratio	0.8328	0.5338	0.6279	0.3425	0.3359	0.6761	0.6635	0.9570	0.3182	0.3243
(C22)	Classical			size:200			**52 cases converge**			
mean	0.2747	0.5312	0.4441	0.4367	0.6530	0.5013	0.7308	0.4522	0.9269	-0.2073
bias	0.0253	-0.1812	0.1559	-0.0367	0.0470	-0.0513	0.0692	0.0478	-0.3770	0.4073
RMSE	0.1620	0.7723	0.6453	0.5379	0.4445	0.7133	0.6922	0.1710	1.9141	1.7721
SD ratio	0.9080	0.7298	0.8363	0.9031	0.8642	0.5712	0.5752	0.7840	0.6865	0.6576

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.00	1.00	1.00	3.00	0.00
(A22)	Classical			size:2000			**51 cases converge**		
mean	0.6171	0.2755	0.4482	1.0187	-0.0724	0.7610	1.8877	3.1176	-0.1696
bias	-0.0171	0.0245	-0.0482	-0.0187	0.0724	0.2390	-0.8877	-0.1176	0.1696
RMSE	0.4994	0.5928	0.0589	0.1799	0.1353	0.3206	0.9781	0.2455	0.2587
SD ratio	0.5698	0.5792	0.7672	0.1991	0.8855	0.8872	30.0359	31.1214	35.5193
(B22)	Classical			size:500			**41 cases converge**		
mean	0.7152	0.1063	0.4090	1.0254	0.0386	1.0032	1.5337	3.0689	-0.0345
bias	-0.1152	0.1937	-0.0090	-0.0254	-0.0386	-0.0032	-0.5337	-0.0689	0.0345
RMSE	0.7504	0.9959	0.0894	0.1968	0.2460	0.4861	0.8317	0.4440	0.4956
SD ratio	0.3316	1.7585	1.0103	0.8261	1.0383	0.8621	15.1973	18.7954	26.4520
(C22)	Classical			size:200			**52 cases converge**		
mean	0.6226	0.2832	0.4155	1.0288	0.0487	1.0929	1.7531	3.0727	-0.0235
bias	-0.0226	0.0168	-0.0155	-0.0288	-0.0487	-0.0929	-0.7531	-0.0727	0.0235
RMSE	0.8177	0.8132	0.1141	0.2874	0.2537	0.5552	1.1462	0.5501	0.4520
SD ratio	0.5792	0.5731	1.0624	1.0005	0.9789	0.8173	9.4846	9.3353	8.8890

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A22)	Classical			size:2000			**51 cases converge**		
mean	0.4374	0.4858	0.4851	0.4777	0.6156	0.4898	0.4994	0.4787	*fixed*
bias	0.0626	0.0142	0.0149	0.0223	-0.1156	0.0102	0.0006	0.0213	
RMSE	0.1936	0.0403	0.0354	0.0623	0.1504	0.0560	0.0210	0.0321	
SD ratio	0.2211	0.9692	1.0583	0.8923	0.9553	0.9251	0.9313	0.8777	
(B22)	Classical			size:500			**41 cases converge**		
mean	0.4824	0.4756	0.4695	0.4705	0.5158	0.4813	0.4739	0.4620	*fixed*
bias	0.0176	0.0244	0.0305	0.0295	-0.0158	0.0187	0.0261	0.0380	
RMSE	0.0999	0.0629	0.0646	0.0893	0.2069	0.0769	0.0590	0.1014	
SD ratio	1.1288	1.0430	0.2854	1.1615	0.7017	1.1510	1.0258	1.0260	
(C22)	Classical			size:200			**52 cases converge**		
mean	0.4655	0.4527	0.4519	0.4669	0.4910	0.4563	0.4350	0.4599	*fixed*
bias	0.0345	0.0473	0.0481	0.0331	0.0090	0.0437	0.0650	0.0401	
RMSE	0.1123	0.1102	0.1193	0.1034	0.2168	0.1255	0.1369	0.1074	
SD ratio	0.8616	1.0423	1.0290	1.1030	0.5746	1.0217	0.9463	1.1345	

Table A.46: Simulation Result of the SEM approach (A23, B23, C23)

Design	Parameters								
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A23)	SEM			size:2000			**106 cases converge**			
mean	0.3017	0.3487	0.5995	0.3989	0.7000	0.4521	0.7985	0.5020	0.5509	0.1987
bias	-0.0017	0.0013	0.0005	0.0011	0.0000	-0.0021	0.0015	-0.0020	-0.0009	0.0013
RMSE	0.0442	0.0317	0.0161	0.0347	0.0175	0.0392	0.0184	0.0543	0.0253	0.0197
SD ratio	0.9579	0.9917	0.9646	0.9905	0.9570	1.0242	0.9156	0.9351	1.0069	0.8761
(B23)	SEM			size:500			**88 cases converge**			
mean	0.2638	0.3361	0.5885	0.3849	0.6879	0.4273	0.7896	0.4461	0.5628	0.1835
bias	0.0362	0.0139	0.0115	0.0151	0.0121	0.0227	0.0104	0.0539	-0.0128	0.0165
RMSE	0.0857	0.0537	0.0387	0.0678	0.0392	0.0752	0.0391	0.1046	0.0478	0.0453
SD ratio	0.9113	0.8148	1.1355	0.9545	1.0415	0.9538	0.9887	0.8330	0.9101	1.0090
(C23)	SEM			size:200			**75 cases converge**			
mean	0.2592	0.3455	0.5831	0.3979	0.6798	0.4481	0.7772	0.4226	0.5624	0.1816
bias	0.0408	0.0045	0.0169	0.0021	0.0202	0.0019	0.0228	0.0774	-0.0124	0.0184
RMSE	0.1329	0.1139	0.0596	0.1024	0.0650	0.1280	0.0663	0.1986	0.0842	0.0647
SD ratio	0.9326	1.1156	1.0971	0.8993	1.1204	1.0367	1.0293	1.1016	1.0803	1.0145

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.00	1.00	1.00	3.00	5.00
(A23)	SEM			size:2000			**106 cases converge**		
mean	0.6017	0.2986	0.3999	0.9996	-0.0058	0.9727	1.0038	3.0056	4.9943
bias	-0.0017	0.0014	0.0001	0.0004	0.0058	0.0273	-0.0038	-0.0056	0.0057
RMSE	0.0277	0.0212	0.0180	0.0839	0.0729	0.1752	0.2014	0.0686	0.1115
SD ratio	1.0898	0.9391	0.8548	0.9790	0.8448	0.8769	0.9338	0.9379	0.9681
(B23)	SEM			size:500			**88 cases converge**		
mean	0.5985	0.2852	0.3880	1.0757	0.0582	1.1545	1.0915	3.0224	5.0204
bias	0.0015	0.0148	0.0120	-0.0757	-0.0582	-0.1545	-0.0915	-0.0224	-0.0204
RMSE	0.0515	0.0461	0.0411	0.1661	0.1377	0.3752	0.4264	0.1461	0.2161
SD ratio	0.9872	1.0575	1.0368	0.9826	0.8327	0.9396	1.0769	1.0076	0.9865
(C23)	SEM			size:200			**75 cases converge**		
mean	0.6051	0.2785	0.3814	1.0613	0.0991	1.3314	1.0829	3.0583	5.0578
bias	-0.0051	0.0215	0.0186	-0.0613	-0.0991	-0.3314	-0.0829	-0.0583	-0.0578
RMSE	0.0917	0.0760	0.0660	0.2551	0.2274	0.7498	0.6637	0.2443	0.3719
SD ratio	1.1386	1.1864	1.1239	1.0391	0.8738	1.1874	1.0541	0.8600	0.9353

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A23)	SEM			size:2000			**106 cases converge**		
mean	0.5003	0.4992	0.4985	0.4980	0.5070	0.4994	0.4995	0.4969	*fixed*
bias	-0.0003	0.0008	0.0015	0.0020	-0.0070	0.0006	0.0005	0.0031	
RMSE	0.0265	0.0188	0.0179	0.0208	0.0822	0.0177	0.0192	0.0209	
SD ratio	0.9963	1.0268	0.9169	0.9798	0.9155	0.9314	0.9904	0.9827	
(B23)	SEM			size:500			**88 cases converge**		
mean	0.4796	0.5103	0.5017	0.4930	0.4103	0.4858	0.4995	0.5055	*fixed*
bias	0.0204	-0.0103	-0.0017	0.0070	0.0897	0.0142	0.0005	-0.0055	
RMSE	0.0563	0.0377	0.0338	0.0424	0.1978	0.0447	0.0433	0.0441	
SD ratio	1.0002	0.9746	0.8649	1.0023	0.9723	1.1117	1.1042	1.0280	
(C23)	SEM			size:200			**75 cases converge**		
mean	0.4735	0.4796	0.4994	0.5043	0.2819	0.4940	0.4986	0.4959	*fixed*
bias	0.0265	0.0204	0.0006	-0.0043	0.2181	0.0060	0.0014	0.0041	
RMSE	0.0825	0.0605	0.0644	0.0828	0.4618	0.0577	0.0643	0.0722	
SD ratio	0.9464	1.0166	1.0484	1.2361	1.3399	0.9483	1.0313	1.0903	

Table A.47: Simulation Result of the Classical approach (A23, B23, C23)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A23)	Classical			size:2000			**45 cases converge**			
mean	0.3280	0.4493	0.5224	0.5578	0.5771	0.6352	0.6518	0.5266	0.6551	0.0883
bias	-0.0280	-0.0993	0.0776	-0.1578	0.1229	-0.1852	0.1482	-0.0266	-0.1051	0.1117
RMSE	0.0867	0.4497	0.3688	0.4915	0.4198	0.5137	0.4154	0.0924	0.3868	0.3986
SD ratio	0.9006	1.2005	1.2252	1.1723	1.2443	1.1963	1.2388	0.6760	0.6712	1.0644
(B23)	Classical			size:500			**39 cases converge**			
mean	0.2752	0.5108	0.4691	0.5516	0.5878	0.5049	0.7391	0.4915	0.5180	0.2342
bias	0.0248	-0.1608	0.1309	-0.1516	0.1122	-0.0549	0.0609	0.0085	0.0320	-0.0342
RMSE	0.0925	0.7108	0.4925	0.5908	0.4349	0.3620	0.2894	0.1315	0.3680	0.4399
SD ratio	0.6285	0.9966	0.9725	1.1469	1.1385	1.0506	1.1699	0.5800	0.9465	0.9332
(C23)	Classical			size:200			**37 cases converge**			
mean	0.2768	0.0832	0.7213	0.3524	0.6968	0.3860	0.7866	0.4536	0.5294	0.2146
bias	0.0232	0.2668	-0.1213	0.0476	0.0032	0.0640	0.0134	0.0464	0.0206	-0.0146
RMSE	0.1682	1.8547	1.0885	0.6668	0.4445	0.4726	0.3112	0.2015	0.3929	0.3926
SD ratio	0.8458	0.9812	0.9431	1.0527	0.9446	0.9111	0.9002	1.0078	1.0037	0.9421

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.00	1.00	1.00	3.00	5.00
(A23)	Classical			size:2000			**45 cases converge**		
mean	0.6032	0.3067	0.4291	0.9703	-0.0608	0.8636	5.6781	3.8341	4.6506
bias	-0.0032	-0.0067	-0.0291	0.0297	0.0608	0.1364	-4.6781	-0.8341	0.3494
RMSE	0.2883	0.3028	0.0583	0.1370	0.1449	0.3488	5.0897	1.0548	0.7569
SD ratio	1.1364	1.1019	0.9566	0.8392	0.7523	0.7416	26.2077	17.2119	21.8607
(B23)	Classical			size:500			**39 cases converge**		
mean	0.6089	0.2627	0.4241	1.0571	0.0032	0.9865	5.5795	4.0660	4.6628
bias	-0.0089	0.0373	-0.0241	-0.0571	-0.0032	0.0135	-4.5795	-1.0660	0.3372
RMSE	0.2507	0.2690	0.0737	0.2139	0.1526	0.5147	5.0663	1.4093	0.9079
SD ratio	0.9260	0.9369	0.7785	0.7028	0.5816	0.6287	13.9148	10.2185	12.0261
(C23)	Classical			size:200			**37 cases converge**		
mean	0.5654	0.2851	0.4321	1.0939	0.0507	0.9954	5.4003	4.1071	4.8761
bias	0.0346	0.0149	-0.0321	-0.0939	-0.0507	0.0046	-4.4003	-1.1071	0.1239
RMSE	0.4559	0.5749	0.0857	0.2623	0.2252	0.4591	4.8906	1.8505	1.5673
SD ratio	0.8681	0.9217	0.7135	0.7221	0.8437	1.0131	8.4575	8.8110	10.5820

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A23)	Classical			size:2000			**45 cases converge**		
mean	0.4863	0.4826	0.4927	0.4903	0.5596	0.4832	0.4956	0.4851	*fixed*
bias	0.0137	0.0174	0.0073	0.0097	-0.0596	0.0168	0.0044	0.0149	
RMSE	0.0509	0.0542	0.0296	0.0447	0.1694	0.0851	0.0294	0.0364	
SD ratio	0.9609	1.4429	1.0306	1.3165	0.7622	0.8222	1.0938	1.1489	
(B23)	Classical			size:500			**39 cases converge**		
mean	0.4418	0.4765	0.4654	0.4775	0.5193	0.4674	0.4934	0.4859	*fixed*
bias	0.0582	0.0235	0.0346	0.0225	-0.0193	0.0326	0.0066	0.0141	
RMSE	0.1454	0.0897	0.0740	0.0597	0.2120	0.0859	0.0560	0.0549	
SD ratio	0.8245	1.0067	1.0467	0.9746	0.4342	0.8998	1.0944	0.9994	
(C23)	Classical			size:200			**37 cases converge**		
mean	0.4206	0.4260	0.4245	0.4842	0.5717	0.4578	0.4582	0.4545	*fixed*
bias	0.0794	0.0740	0.0755	0.0158	-0.0717	0.0422	0.0418	0.0455	
RMSE	0.1740	0.1195	0.1292	0.0856	0.1681	0.0934	0.0992	0.1035	
SD ratio	0.9050	0.7076	0.7870	1.0919	0.6980	0.9466	1.0543	0.7843	

Table A.48: Simulation Result of the SEM approach (A24, B24, C24)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A24)	SEM			size:2000			**103 cases converge**			
mean	0.3021	0.3544	0.5986	0.4012	0.6999	0.4516	0.8003	0.4941	0.5490	0.2026
bias	-0.0021	-0.0044	0.0014	-0.0012	0.0001	-0.0016	-0.0003	0.0059	0.0010	-0.0026
RMSE	0.0488	0.0408	0.0123	0.0434	0.0119	0.0425	0.0120	0.0644	0.0195	0.0304
SD ratio	0.7934	0.9764	1.0672	0.9303	0.9868	0.8177	0.9418	0.8965	0.9588	0.9033
(B24)	SEM			size:500			**86 cases converge**			
mean	0.2637	0.3347	0.5996	0.3718	0.7044	0.4297	0.7990	0.4070	0.5594	0.1830
bias	0.0363	0.0153	0.0004	0.0282	-0.0044	0.0203	0.0010	0.0930	-0.0094	0.0170
RMSE	0.0906	0.0792	0.0252	0.0752	0.0244	0.0856	0.0269	0.1794	0.0377	0.0630
SD ratio	0.8247	1.0496	1.1370	0.8445	1.0304	0.9204	1.0879	1.0910	0.9522	1.0526
(C24)	SEM			size:200			**61 cases converge**			
mean	0.2267	0.3018	0.6013	0.3539	0.7004	0.3914	0.8032	0.3246	0.5653	0.1615
bias	0.0733	0.0482	-0.0013	0.0461	-0.0004	0.0586	-0.0032	0.1754	-0.0153	0.0385
RMSE	0.1546	0.1245	0.0340	0.1272	0.0346	0.1319	0.0331	0.3134	0.0553	0.1054
SD ratio	0.9724	1.0608	1.0228	0.9824	0.9753	0.8952	0.8928	1.2415	0.8346	1.0728

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.00	1.00	1.00	3.00	0.00
(A24)	SEM			size:2000			**103 cases converge**		
mean	0.5953	0.3061	0.4020	0.9907	0.0055	1.0119	1.0015	2.9990	0.0006
bias	0.0047	-0.0061	-0.0020	0.0093	-0.0055	-0.0119	-0.0015	0.0010	-0.0006
RMSE	0.0189	0.0359	0.0353	0.0808	0.0985	0.2392	0.0584	0.0671	0.0917
SD ratio	0.9840	0.8925	0.7768	0.8075	0.8646	0.9068	0.8099	0.8109	0.8539
(B24)	SEM			size:500			**86 cases converge**		
mean	0.6013	0.2697	0.3608	1.0494	0.1008	1.4010	0.9605	3.0321	0.0929
bias	-0.0013	0.0303	0.0393	-0.0494	-0.1008	-0.4010	0.0395	-0.0321	-0.0929
RMSE	0.0390	0.0740	0.0822	0.1371	0.2032	0.7815	0.1096	0.1146	0.1983
SD ratio	0.9980	0.9877	0.9321	0.8198	0.9276	1.1262	0.8983	0.8338	0.9472
(C24)	SEM			size:200			**61 cases converge**		
mean	0.6010	0.2696	0.3662	1.1034	0.2315	1.8285	0.9307	3.1018	0.1976
bias	-0.0010	0.0304	0.0338	-0.1034	-0.2315	-0.8285	0.0693	-0.1018	-0.1976
RMSE	0.0605	0.0914	0.1082	0.2212	0.3622	1.5903	0.1510	0.1725	0.3145
SD ratio	0.9377	0.8598	0.9370	0.9135	1.0842	1.3656	0.8395	0.7690	0.9519

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A24)	SEM			size:2000			**103 cases converge**		
mean	0.5014	0.5006	0.4971	0.4981	0.4954	0.5002	0.4994	0.4974	*fixed*
bias	-0.0014	-0.0006	0.0029	0.0019	0.0046	-0.0002	0.0006	0.0026	
RMSE	0.0228	0.0191	0.0180	0.0195	0.1188	0.0196	0.0182	0.0233	
SD ratio	0.9233	1.0415	0.9181	0.9283	0.8975	1.0132	0.9459	1.0085	
(B24)	SEM			size:500			**86 cases converge**		
mean	0.4949	0.4954	0.5008	0.4914	0.2285	0.4884	0.4993	0.5101	*fixed*
bias	0.0051	0.0046	-0.0008	0.0086	0.2715	0.0116	0.0007	-0.0101	
RMSE	0.0526	0.0374	0.0366	0.0409	0.5556	0.0353	0.0352	0.0510	
SD ratio	1.0731	1.0226	0.9427	0.9676	1.2874	0.8738	0.8978	1.0815	
(C24)	SEM			size:200			**61 cases converge**		
mean	0.4885	0.4922	0.5036	0.4937	-0.0725	0.4847	0.5070	0.5033	*fixed*
bias	0.0115	0.0078	-0.0036	0.0063	0.5725	0.0153	-0.0070	-0.0033	
RMSE	0.0845	0.0431	0.0629	0.0652	1.2242	0.0611	0.0718	0.0774	
SD ratio	1.0946	0.7438	1.0196	0.9939	1.4771	0.9644	1.1128	1.0604	

Table A.49: Simulation Result of the Classical approach (A24, B24, C24)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A24)	Classical			size:2000			**49 cases converge**			
mean	0.3286	0.4815	0.5021	0.6351	0.5090	0.5480	0.7288	0.5321	0.7786	-0.0428
bias	-0.0286	-0.1315	0.0979	-0.2351	0.1910	-0.0980	0.0712	-0.0321	-0.2286	0.2428
RMSE	0.0819	0.6376	0.5313	1.7781	1.4989	0.6471	0.5464	0.0951	0.8514	0.9225
SD ratio	0.8541	0.5761	0.5790	0.6895	0.6911	0.6223	0.6263	0.6689	0.4544	0.4492
(B24)	Classical			size:500			**39 cases converge**			
mean	0.3225	0.4494	0.5191	0.5723	0.5856	0.6820	0.6241	0.5094	0.7968	-0.0747
bias	-0.0225	-0.0994	0.0809	-0.1723	0.1144	-0.2320	0.1759	-0.0095	-0.2468	0.2747
RMSE	0.1084	0.4208	0.3558	0.5765	0.4897	0.6358	0.5602	0.1072	0.8102	0.9205
SD ratio	1.4578	0.3392	0.3511	0.1909	0.1938	0.6189	0.6290	1.1347	0.7351	0.7621
(C24)	Classical			size:200			**39 cases converge**			
mean	0.2178	0.3623	0.5483	0.4921	0.6096	0.6083	0.6307	0.3925	0.5659	0.1251
bias	0.0822	-0.0123	0.0517	-0.0921	0.0904	-0.1583	0.1693	0.1075	-0.0159	0.0749
RMSE	0.2093	0.7408	0.5267	0.6961	0.4708	1.0307	0.7285	0.3157	0.3821	0.4289
SD ratio	0.8460	0.4885	0.5309	0.4549	0.4803	0.4740	0.5046	0.7911	0.5916	0.6056

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	1.00	0.00	1.00	1.00	3.00	0.00
(A24)	Classical			size:2000			**49 cases converge**		
mean	0.5523	0.3608	0.4288	0.9582	-0.0490	0.8551	1.8403	3.0870	-0.1142
bias	0.0477	-0.0608	-0.0288	0.0419	0.0490	0.1449	-0.8403	-0.0870	0.1142
RMSE	0.3415	0.3637	0.0558	0.1455	0.1445	0.3515	0.9660	0.2612	0.2682
SD ratio	0.7122	0.6974	0.8961	0.8116	0.7829	0.7168	30.8211	32.9132	40.2494
(B24)	Classical			size:500			**39 cases converge**		
mean	0.5703	0.3309	0.4328	1.0172	-0.0222	0.9297	1.9226	3.0971	-0.0618
bias	0.0297	-0.0310	-0.0329	-0.0172	0.0222	0.0703	-0.9226	-0.0971	0.0618
RMSE	0.2243	0.2221	0.0716	0.2372	0.1626	0.3667	1.0966	0.3379	0.2819
SD ratio	0.5368	0.4865	1.4042	0.9325	0.7842	0.7481	13.7994	13.5636	13.4994
(C24)	Classical			size:200			**39 cases converge**		
mean	0.6229	0.2285	0.4135	1.0928	0.1626	1.2766	1.5623	3.2246	0.1654
bias	-0.0229	0.0715	-0.0135	-0.0928	-0.1626	-0.2766	-0.5623	-0.2246	-0.1654
RMSE	0.5993	0.7043	0.1181	0.3021	0.3462	0.8839	0.9789	0.5850	0.6604
SD ratio	0.4243	0.4122	0.8243	0.9022	0.8432	0.9078	9.4947	9.3641	12.7470

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A24)	Classical			size:2000			**49 cases converge**		
mean	0.4740	0.4983	0.4841	0.4914	0.5757	0.4834	0.4937	0.4886	*fixed*
bias	0.0260	0.0018	0.0159	0.0086	-0.0757	0.0166	0.0064	0.0114	
RMSE	0.0708	0.0265	0.0448	0.0261	0.1758	0.0701	0.0281	0.0273	
SD ratio	0.8618	1.0820	1.1417	0.9333	0.7173	0.5897	0.8272	0.8526	
(B24)	Classical			size:500			**39 cases converge**		
mean	0.4497	0.4625	0.4564	0.4536	0.5404	0.4653	0.4923	0.4857	*fixed*
bias	0.0503	0.0375	0.0436	0.0464	-0.0404	0.0347	0.0078	0.0144	
RMSE	0.1558	0.0922	0.0903	0.0937	0.1628	0.0809	0.0414	0.0497	
SD ratio	1.0983	1.2572	1.1168	0.9625	0.6642	0.2882	0.8885	0.9800	
(C24)	Classical			size:200			**39 cases converge**		
mean	0.4705	0.4726	0.4638	0.4173	0.5268	0.4702	0.4574	0.4677	*fixed*
bias	0.0295	0.0274	0.0362	0.0827	-0.0268	0.0298	0.0426	0.0323	
RMSE	0.1324	0.0650	0.1112	0.1580	0.3088	0.0844	0.1057	0.1319	
SD ratio	1.0764	0.8679	0.9962	1.0050	0.5312	1.0691	0.9902	0.7610	

Table A.50: Simulation Result of the SEM approach (A25, B25, C25)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A25)	SEM			size:2000			**110 cases converge**			
mean	0.2903	0.3430	0.5990	0.3934	0.6991	0.4468	0.8015	0.4890	0.5492	0.1984
bias	0.0097	0.0070	0.0010	0.0066	0.0009	0.0032	-0.0015	0.0110	0.0008	0.0016
RMSE	0.0645	0.0463	0.0095	0.0472	0.0102	0.0575	0.0115	0.0872	0.0292	0.0090
SD ratio	1.0186	0.9958	0.9183	0.9053	0.9281	0.9937	0.9737	0.9344	0.9869	0.8626
(B25)	SEM			size:500			**109 cases converge**			
mean	0.3146	0.3490	0.5999	0.3989	0.7016	0.4533	0.7994	0.5089	0.5614	0.1943
bias	-0.0146	0.0010	0.0001	0.0011	-0.0016	-0.0033	0.0006	-0.0089	-0.0114	0.0057
RMSE	0.1245	0.0903	0.0214	0.1084	0.0246	0.1118	0.0264	0.2152	0.0641	0.0258
SD ratio	0.9757	0.9896	1.0342	1.0561	1.1217	0.9718	1.1280	1.1793	1.0757	1.1938
(C25)	SEM			size:200			**106 cases converge**			
mean	0.2752	0.3459	0.5963	0.3874	0.7020	0.4387	0.8033	0.4477	0.5343	0.1975
bias	0.0248	0.0041	0.0037	0.0126	-0.0020	0.0113	-0.0033	0.0523	0.0157	0.0025
RMSE	0.2024	0.1555	0.0342	0.1739	0.0388	0.1951	0.0389	0.4306	0.1115	0.0421
SD ratio	1.0267	1.1093	1.0553	1.0920	1.1214	1.0997	1.0656	1.3640	1.2785	1.3565

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	3.00	0.50	5.00	1.00	3.00	5.00
(A25)	SEM			size:2000			**110 cases converge**		
mean	0.5972	0.2996	0.3995	3.0181	0.5176	5.0381	0.9258	2.9743	5.0079
bias	0.0028	0.0004	0.0005	-0.0181	-0.0176	-0.0381	0.0742	0.0257	-0.0079
RMSE	0.0316	0.0107	0.0108	0.1319	0.1669	0.3868	0.1130	0.0828	0.0948
SD ratio	0.9958	0.9149	0.9377	0.9779	1.0679	1.0048	0.9128	1.0525	0.8523
(B25)	SEM			size:500			**109 cases converge**		
mean	0.6006	0.2990	0.4014	2.9696	0.4857	4.9232	0.9380	2.9617	4.9753
bias	-0.0006	0.0010	-0.0014	0.0304	0.0143	0.0768	0.0620	0.0383	0.0247
RMSE	0.0552	0.0255	0.0270	0.3162	0.3561	0.9318	0.2160	0.1583	0.2634
SD ratio	0.9019	1.1053	1.1991	1.1516	1.1460	1.2104	1.0960	0.9956	1.0944
(C25)	SEM			size:200			**106 cases converge**		
mean	0.6050	0.2939	0.3980	2.9715	0.5213	5.3836	0.9256	3.0002	5.0403
bias	-0.0050	0.0061	0.0020	0.0285	-0.0213	-0.3836	0.0744	-0.0002	-0.0403
RMSE	0.1141	0.0439	0.0452	0.4541	0.5418	1.8870	0.3441	0.2556	0.5009
SD ratio	1.2241	1.2332	1.3024	1.0700	1.1165	1.4125	1.2039	1.0445	1.1549

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A25)	SEM			size:2000			**110 cases converge**		
mean	0.4970	0.4998	0.5007	0.5020	0.4729	0.4984	0.4995	0.4983	*mis-specified at 0.1*
bias	0.0030	0.0002	-0.0007	-0.0020	0.0271	0.0016	0.0005	0.0017	
RMSE	0.0299	0.0166	0.0175	0.0221	0.1682	0.0180	0.0230	0.0266	
SD ratio	1.0470	0.8947	0.8802	1.0088	0.8973	0.8311	1.0661	1.1447	
(B25)	SEM			size:500			**109 cases converge**		
mean	0.5006	0.5041	0.4888	0.5004	0.4373	0.4892	0.5073	0.4968	*mis-specified at 0.1*
bias	-0.0006	-0.0041	0.0112	-0.0004	0.0627	0.0108	-0.0073	0.0032	
RMSE	0.0600	0.0375	0.0398	0.0421	0.5324	0.0515	0.0474	0.0443	
SD ratio	1.0614	0.9940	0.9733	0.9677	1.3580	1.1529	1.0788	0.9570	
(C25)	SEM			size:200			**106 cases converge**		
mean	0.4895	0.4963	0.4859	0.4866	0.1354	0.4990	0.4862	0.4996	*mis-specified at 0.1*
bias	0.0105	0.0037	0.0141	0.0134	0.3646	0.0010	0.0138	0.0004	
RMSE	0.1068	0.0606	0.0578	0.0726	1.3950	0.0718	0.0795	0.0718	
SD ratio	1.1846	1.0225	0.8988	1.0459	1.6342	1.0638	1.1279	0.9633	

Table A.51: Simulation Result of the SEM approach (A26, B26, C26)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A26)	SEM			size:2000			**110 cases converge**			
mean	0.3042	0.3475	0.6010	0.4001	0.7005	0.4551	0.8010	0.4625	0.5440	0.1995
bias	-0.0042	0.0025	-0.0010	-0.0001	-0.0005	-0.0051	-0.0010	0.0375	0.0060	0.0005
RMSE	0.0802	0.0580	0.0114	0.0673	0.0128	0.0734	0.0141	0.1041	0.0203	0.0127
SD ratio	1.1376	1.1028	1.0012	1.1301	1.0492	1.0968	1.0642	1.0531	0.9989	1.0117
(B26)	SEM			size:500			**110 cases converge**			
mean	0.3256	0.3724	0.5935	0.4212	0.6958	0.4744	0.7983	0.4733	0.5441	0.2050
bias	-0.0256	-0.0224	0.0065	-0.0212	0.0042	-0.0244	0.0017	0.0267	0.0059	-0.0050
RMSE	0.1674	0.1165	0.0248	0.1311	0.0288	0.1520	0.0284	0.2051	0.0415	0.0284
SD ratio	1.1011	1.0445	0.9806	1.0427	1.0878	1.0742	1.0070	1.1212	1.0770	1.1024
(C26)	SEM			size:200			**102 cases converge**			
mean	0.3057	0.3634	0.5860	0.4098	0.6872	0.4645	0.7876	0.4242	0.5405	0.2017
bias	-0.0057	-0.0134	0.0140	-0.0098	0.0128	-0.0145	0.0124	0.0758	0.0095	-0.0017
RMSE	0.2514	0.1843	0.0523	0.2068	0.0563	0.2325	0.0573	0.3929	0.0688	0.0409
SD ratio	1.0233	1.0684	1.2757	1.0617	1.2818	1.0427	1.2018	1.2876	1.1806	1.0983

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	3.00	0.50	5.00	1.00	3.00	0.00
(A26)	SEM			size:2000			**110 cases converge**		
mean	0.5986	0.2970	0.3955	2.9866	0.5231	5.1395	0.9110	2.9699	0.0211
bias	0.0014	0.0030	0.0045	0.0134	-0.0231	-0.1395	-0.0890	0.0301	-0.0211
RMSE	0.0189	0.0165	0.0228	0.1599	0.1859	0.5011	0.1167	0.1064	0.1293
SD ratio	0.9748	0.9786	1.0740	1.1644	1.1212	1.0559	1.0733	1.1522	1.0273
(B26)	SEM			size:500			**110 cases converge**		
mean	0.5971	0.3055	0.3990	2.9505	0.4960	5.1418	0.9445	2.9192	0.0021
bias	0.0029	-0.0055	0.0010	0.0495	0.0040	-0.1418	0.0555	0.0808	-0.0021
RMSE	0.0416	0.0362	0.0456	0.3089	0.3552	1.0120	0.1601	0.2342	0.2564
SD ratio	1.1042	1.1012	1.1492	1.0108	1.0437	1.1022	1.0139	1.0865	1.0010
(C26)	SEM			size:200			**102 cases converge**		
mean	0.5933	0.2971	0.3988	2.9429	0.5146	5.6266	1.0272	2.8942	-0.0594
bias	0.0067	0.0029	0.0012	0.0571	-0.0146	-0.6266	-0.0272	0.1058	0.0594
RMSE	0.0673	0.0541	0.0709	0.4978	0.6016	2.0268	0.4499	0.5619	0.6355
SD ratio	1.1587	1.1587	1.2211	0.9334	1.0877	1.1926	1.6868	1.2822	1.4139

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A26)	SEM			size:2000			**110 cases converge**		
mean	0.5003	0.4998	0.5019	0.4977	0.4034	0.4999	0.5021	0.4993	*mis-specified at 0.1*
bias	-0.0003	0.0002	-0.0019	0.0023	0.0967	0.0001	-0.0021	0.0007	
RMSE	0.0306	0.0202	0.0188	0.0224	0.2978	0.0183	0.0199	0.0270	
SD ratio	1.0587	1.0908	0.9413	1.0333	1.0556	0.8890	0.9713	1.0665	
(B26)	SEM			size:500			**110 cases converge**		
mean	0.4875	0.4944	0.4984	0.4975	0.3777	0.4974	0.4976	0.5008	*mis-specified at 0.1*
bias	0.0125	0.0056	0.0016	0.0025	0.1223	0.0026	0.0024	-0.0008	
RMSE	0.0630	0.0388	0.0407	0.0457	0.7246	0.0423	0.0408	0.0523	
SD ratio	1.0579	1.0425	1.0243	1.0530	1.2925	1.0417	1.0016	1.0562	
(C26)	SEM			size:200			**102 cases converge**		
mean	0.4705	0.4935	0.4887	0.5057	-0.0142	0.5048	0.4878	0.5103	*mis-specified at 0.1*
bias	0.0295	0.0065	0.0113	-0.0057	0.5142	-0.0048	0.0122	-0.0103	
RMSE	0.1236	0.0618	0.0645	0.0635	1.5555	0.0664	0.0610	0.0910	
SD ratio	1.2261	1.0506	1.0111	0.9159	1.2645	1.0361	0.9211	1.1269	

Table A.52: Simulation Result of the SEM approach (A27, B27, C27)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A27)	SEM			size:2000			**110 cases converge**			
mean	0.3003	0.3502	0.6016	0.3985	0.7004	0.4458	0.8003	0.4892	0.5485	0.1993
bias	-0.0003	-0.0002	-0.0016	0.0015	-0.0004	0.0042	-0.0003	0.0108	0.0015	0.0007
RMSE	0.0595	0.0480	0.0118	0.0503	0.0125	0.0585	0.0127	0.1048	0.0290	0.0114
SD ratio	0.9383	1.0162	1.0630	0.9472	1.0694	0.9872	1.0284	1.0500	0.9789	1.0629
(B27)	SEM			size:500			**110 cases converge**			
mean	0.2953	0.3428	0.6032	0.3998	0.6993	0.4328	0.8049	0.4500	0.5472	0.1994
bias	0.0047	0.0072	-0.0032	0.0002	0.0007	0.0172	-0.0049	0.0500	0.0028	0.0006
RMSE	0.1494	0.1086	0.0219	0.1183	0.0240	0.1350	0.0277	0.2781	0.0568	0.0236
SD ratio	1.2187	1.2250	0.9875	1.1773	1.0199	1.1834	1.0481	1.2315	1.0525	1.1876
(C27)	SEM			size:200			**96 cases converge**			
mean	0.2987	0.3441	0.6098	0.4223	0.6935	0.4606	0.7998	0.4877	0.5492	0.1975
bias	0.0013	0.0059	-0.0098	-0.0223	0.0065	-0.0106	0.0002	0.0123	0.0008	0.0025
RMSE	0.2168	0.1529	0.0391	0.1820	0.0428	0.2126	0.0460	0.3945	0.1123	0.0481
SD ratio	1.0677	1.0404	1.1009	1.0988	1.1492	1.1497	1.1565	1.2960	1.2885	1.4363

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	3.00	0.50	5.00	1.00	3.00	5.00
(A27)	SEM			size:2000			**110 cases converge**		
mean	0.6018	0.2977	0.3971	2.9842	0.5117	5.0716	1.0846	3.0177	5.0183
bias	-0.0018	0.0023	0.0029	0.0158	-0.0117	-0.0716	-0.0846	-0.0177	-0.0183
RMSE	0.0361	0.0134	0.0132	0.1429	0.1750	0.4192	0.1346	0.0816	0.1431
SD ratio	1.1504	1.0515	1.0203	1.0561	1.0799	1.0025	1.1128	0.9585	1.0957
(B27)	SEM			size:500			**110 cases converge**		
mean	0.5992	0.2964	0.3949	2.9622	0.5323	5.2329	1.0822	3.0356	5.0846
bias	0.0008	0.0036	0.0051	0.0378	-0.0323	-0.2329	-0.0822	-0.0356	-0.0846
RMSE	0.0646	0.0295	0.0322	0.3402	0.4310	1.2262	0.2128	0.1812	0.3703
SD ratio	1.1201	1.2188	1.2367	1.2270	1.3120	1.3054	1.0506	1.0571	1.2239
(C27)	SEM			size:200			**96 cases converge**		
mean	0.5911	0.2979	0.4013	2.8820	0.4618	5.1987	1.0593	3.0731	5.0492
bias	0.0089	0.0021	-0.0013	0.1180	0.0382	-0.1987	-0.0593	-0.0731	-0.0492
RMSE	0.1167	0.0478	0.0493	0.4923	0.5325	1.6870	0.4874	0.2908	0.6252
SD ratio	1.2679	1.3131	1.3439	1.0970	1.0808	1.2303	1.5496	0.9637	1.2448

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A27)	SEM			size:2000			**110 cases converge**		
mean	0.4976	0.4971	0.4999	0.4997	0.4519	0.5044	0.4956	0.5030	*mis-specified at 0.05*
bias	0.0024	0.0029	0.0001	0.0003	0.0481	-0.0044	0.0044	-0.0030	
RMSE	0.0249	0.0191	0.0196	0.0203	0.2092	0.0225	0.0217	0.0250	
SD ratio	0.8675	1.0227	0.9866	0.9398	0.9966	1.0252	0.9833	1.0619	
(B27)	SEM			size:500			**110 cases converge**		
mean	0.5018	0.5024	0.5027	0.4913	0.2638	0.4944	0.4971	0.5035	*mis-specified at 0.05*
bias	-0.0018	-0.0024	-0.0027	0.0087	0.2362	0.0056	0.0029	-0.0035	
RMSE	0.0599	0.0371	0.0410	0.0399	0.8427	0.0447	0.0410	0.0462	
SD ratio	1.0490	0.9881	1.0211	0.9050	1.4937	1.0449	0.9459	0.9778	
(C27)	SEM			size:200			**96 cases converge**		
mean	0.4890	0.4944	0.4824	0.5073	0.2541	0.4906	0.4922	0.4967	*mis-specified at 0.05*
bias	0.0110	0.0056	0.0176	-0.0073	0.2459	0.0094	0.0078	0.0033	
RMSE	0.0944	0.0610	0.0691	0.0661	1.2270	0.0821	0.0702	0.0850	
SD ratio	1.0297	1.0308	1.0791	0.9379	1.4431	1.1909	1.0277	1.1454	

Table A.53: Simulation Result of the SEM approach (A28, B28, C28)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.30	0.35	0.60	0.40	0.70	0.45	0.80	0.50	0.55	0.20
(A28)	SEM			size:2000			**110 cases converge**			
mean	0.3036	0.3526	0.6015	0.4008	0.6996	0.4489	0.7984	0.5076	0.5561	0.1987
bias	-0.0036	-0.0026	-0.0015	-0.0008	0.0004	0.0011	0.0016	-0.0076	-0.0061	0.0014
RMSE	0.0710	0.0495	0.0124	0.0577	0.0132	0.0676	0.0146	0.0856	0.0182	0.0117
SD ratio	1.0007	0.9440	1.0094	0.9765	1.0142	1.0216	1.0422	1.0425	0.9104	0.9268
(B28)	SEM			size:500			**108 cases converge**			
mean	0.3598	0.3923	0.5944	0.4412	0.6972	0.4917	0.7949	0.5197	0.5510	0.2034
bias	-0.0598	-0.0423	0.0056	-0.0412	0.0028	-0.0417	0.0051	-0.0197	-0.0010	-0.0034
RMSE	0.1868	0.1289	0.0272	0.1403	0.0305	0.1547	0.0282	0.1768	0.0386	0.0256
SD ratio	1.1273	1.0925	0.9829	1.0583	1.0629	1.0497	0.9098	1.1015	1.0568	1.0012
(C28)	SEM			size:200			**96 cases converge**			
mean	0.3267	0.3650	0.5978	0.4239	0.6884	0.4733	0.7920	0.4362	0.5500	0.2032
bias	-0.0267	-0.0150	0.0022	-0.0239	0.0116	-0.0233	0.0080	0.0638	0.0000	-0.0032
RMSE	0.2569	0.1834	0.0472	0.2082	0.0549	0.2263	0.0514	0.3431	0.0587	0.0460
SD ratio	1.0846	1.1016	1.1308	1.1085	1.1848	1.0681	1.0646	1.2159	1.0632	1.2099

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
true value	0.60	0.30	0.40	3.00	0.50	5.00	1.00	3.00	0.00
(A28)	SEM			size:2000			**110 cases converge**		
mean	0.6008	0.3003	0.4012	2.9890	0.4772	5.0141	1.0831	3.0236	-0.0047
bias	-0.0008	-0.0003	-0.0012	0.0110	0.0228	-0.0141	-0.0831	-0.0236	0.0047
RMSE	0.0172	0.0174	0.0199	0.1460	0.1681	0.4530	0.1154	0.0948	0.1312
SD ratio	0.9901	1.0882	0.9957	1.0668	1.0423	1.0823	1.0212	0.9093	0.9739
(B28)	SEM			size:500			**108 cases converge**		
mean	0.6006	0.3040	0.4061	2.8828	0.4196	4.9318	1.1382	2.9016	-0.0704
bias	-0.0006	-0.0040	-0.0061	0.1172	0.0804	0.0682	-0.1382	0.0984	0.0704
RMSE	0.0367	0.0325	0.0430	0.3844	0.3715	0.8837	0.2554	0.3331	0.3320
SD ratio	1.0832	1.0220	1.0971	1.1375	1.0607	1.0715	1.2441	1.2440	1.1412
(C28)	SEM			size:200			**96 cases converge**		
mean	0.5868	0.2980	0.3947	2.8919	0.5289	5.4267	1.1462	2.9031	-0.0648
bias	0.0132	0.0020	0.0053	0.1081	-0.0289	-0.4267	-0.1462	0.0969	0.0648
RMSE	0.0540	0.0525	0.0710	0.6161	0.6425	1.7638	0.3488	0.4706	0.5683
SD ratio	0.9902	1.1097	1.2311	1.1925	1.2181	1.1340	1.2348	1.1574	1.2624

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.10
(A28)	SEM			size:2000			**110 cases converge**		
mean	0.5017	0.4979	0.5004	0.5000	0.4971	0.4972	0.5007	0.5012	*mis-specified at 0.05*
bias	-0.0017	0.0021	-0.0004	0.0001	0.0029	0.0028	-0.0007	-0.0012	
RMSE	0.0296	0.0179	0.0188	0.0208	0.2537	0.0204	0.0179	0.0225	
SD ratio	1.0126	0.9627	0.9471	0.9625	1.0746	0.9775	0.8927	0.8920	
(B28)	SEM			size:500			**108 cases converge**		
mean	0.5022	0.5030	0.4950	0.4930	0.5107	0.5017	0.4930	0.4842	*mis-specified at 0.05*
bias	-0.0022	-0.0030	0.0050	0.0070	-0.0107	-0.0017	0.0070	0.0158	
RMSE	0.0556	0.0330	0.0339	0.0454	0.4817	0.0429	0.0385	0.0511	
SD ratio	0.9424	0.8782	0.8479	1.0451	1.0247	1.0503	0.9510	0.9947	
(C28)	SEM			size:200			**96 cases converge**		
mean	0.4804	0.4997	0.5024	0.4932	0.1231	0.4958	0.5024	0.4976	*mis-specified at 0.05*
bias	0.0196	0.0003	-0.0024	0.0068	0.3769	0.0042	-0.0024	0.0024	
RMSE	0.0924	0.0599	0.0654	0.0692	1.3465	0.0644	0.0585	0.0884	
SD ratio	0.9687	1.0091	1.0284	1.0074	1.2643	1.0076	0.9079	1.1414	

Table A.54: Simulation Result of the SEM approach (A29 - A33)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A29)	SEM			size:2000						
mean	0.6515	0.6996	0.6005	0.7449	0.7010	0.7999	0.7998	0.8515	0.9012	0.2005
bias	-0.0015	0.0004	-0.0005	0.0051	-0.0010	0.0001	0.0002	-0.0015	-0.0012	-0.0005
RMSE	0.0542	0.0448	0.0123	0.0494	0.0100	0.0570	0.0123	0.0743	0.0179	0.0139
SD ratio	0.9758	1.0226	1.1542	1.0221	0.9104	1.0797	1.0722	1.0739	1.0086	0.9767
(A30)	SEM			size:2000						
mean	0.6530	0.7009	0.6006	0.7461	0.7010	0.8014	0.7998	0.8569	0.9025	0.2003
bias	-0.0030	-0.0009	-0.0006	0.0039	-0.0010	-0.0014	0.0002	-0.0068	-0.0025	-0.0003
RMSE	0.0533	0.0449	0.0121	0.0489	0.0098	0.0562	0.0117	0.0895	0.0220	0.0135
SD ratio	0.9667	1.0397	1.1996	1.0278	0.9358	1.0805	1.0698	1.1332	1.0252	0.9669
(A31)	SEM			size:2000						
mean	0.6530	0.7011	0.6007	0.7463	0.7012	0.8015	0.8000	0.8595	0.9035	0.2003
bias	-0.0030	-0.0011	-0.0007	0.0037	-0.0012	-0.0015	0.0000	-0.0095	-0.0035	-0.0003
RMSE	0.0519	0.0435	0.0117	0.0472	0.0098	0.0539	0.0114	0.0848	0.0257	0.0126
SD ratio	0.9699	1.0506	1.1935	1.0339	0.9487	1.0803	1.0603	1.0984	1.0367	0.9472

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
(A29)	SEM			size:2000					
true value	0.95	0.30	0.40	3.00	0.50	5.00	1.00	3.00	**0.50**
mean	0.9502	0.2995	0.4006	3.0030	0.5048	4.9814	1.0030	3.0071	0.4956
bias	-0.0002	0.0005	-0.0006	-0.0030	-0.0048	0.0186	-0.0030	-0.0071	0.0044
RMSE	0.0199	0.0192	0.0231	0.1347	0.1556	0.4821	0.0379	0.0686	0.1042
SD ratio	1.1188	1.0621	1.0285	1.0342	0.9677	1.1003	0.9806	0.9134	0.9914
(A30)	SEM			size:2000					
true value	0.95	0.30	0.40	3.00	0.50	5.00	1.00	3.00	**1.50**
mean	0.9510	0.3006	0.4024	2.9997	0.4986	4.9532	1.0016	3.0071	1.4917
bias	-0.0010	-0.0006	-0.0024	0.0003	0.0014	0.0468	-0.0016	-0.0071	0.0083
RMSE	0.0237	0.0186	0.0224	0.1349	0.1720	0.5372	0.0406	0.0637	0.1123
SD ratio	1.1147	1.0598	1.0551	1.0241	1.0249	1.1708	1.0151	0.8994	1.0467
(A31)	SEM			size:2000					
true value	0.95	0.30	0.40	3.00	0.50	5.00	1.00	3.00	**2.50**
mean	0.9514	0.3008	0.4024	2.9996	0.4971	4.9404	0.9996	3.0088	2.4910
bias	-0.0014	-0.0008	-0.0024	0.0004	0.0029	0.0596	0.0004	-0.0088	0.0090
RMSE	0.0271	0.0161	0.0179	0.1315	0.1669	0.4893	0.0492	0.0636	0.1077
SD ratio	1.1136	1.0318	1.0479	1.0096	1.0161	1.1519	1.0020	0.9024	1.0212

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A29)	SEM			size:2000					
mean	0.4997	0.5004	0.4997	0.4993	0.4797	0.4994	0.4988	0.5008	*fixed*
bias	0.0003	-0.0004	0.0003	0.0007	0.0203	0.0006	0.0012	-0.0008	
RMSE	0.0300	0.0117	0.0205	0.0223	0.2764	0.0224	0.0208	0.0248	
SD ratio	1.0519	0.9434	1.0338	1.0370	1.0767	1.0226	0.9899	0.9797	
(A30)	SEM			size:2000					
mean	0.4998	0.5003	0.4997	0.4992	0.4961	0.4991	0.4987	0.4998	*fixed*
bias	0.0002	-0.0003	0.0003	0.0008	0.0039	0.0009	0.0014	0.0002	
RMSE	0.0299	0.0176	0.0206	0.0223	0.2913	0.0226	0.0210	0.0242	
SD ratio	1.0574	0.9371	1.0370	1.0369	1.1476	1.0178	0.9848	0.9824	
(A31)	SEM			size:2000					
mean	0.4999	0.5002	0.4997	0.4992	0.5062	0.4987	0.4987	0.5000	*fixed*
bias	0.0001	-0.0003	0.0003	0.0008	-0.0062	0.0013	0.0013	0.0000	
RMSE	0.0299	0.0176	0.0206	0.0223	0.2416	0.0229	0.0215	0.0228	
SD ratio	1.0598	0.9345	1.0383	1.0356	1.1047	1.0181	0.9956	0.9634	

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(**A32**)	SEM			size:2000						
mean	0.6527	0.7010	0.6009	0.7462	0.7013	0.8013	0.8001	0.8595	0.9035	0.2006
bias	-0.0027	-0.0010	-0.0009	0.0038	-0.0013	-0.0013	-0.0001	-0.0095	-0.0035	-0.0006
RMSE	0.0509	0.0422	0.0116	0.0460	0.0100	0.0522	0.0114	0.0848	0.0257	0.0126
SD ratio	0.9736	1.0513	1.1709	1.0421	0.9587	1.0816	1.0557	1.0480	1.0167	0.9313
(**A33**)	SEM			size:2000						
mean	0.6524	0.7009	0.6010	0.7461	0.7014	0.8012	0.8002	0.8592	0.9034	0.2007
bias	-0.0024	-0.0009	-0.0010	0.0039	-0.0014	-0.0012	-0.0002	-0.0092	-0.0034	-0.0007
RMSE	0.0503	0.0412	0.0117	0.0453	0.0102	0.0512	0.0116	0.0692	0.0259	0.0108
SD ratio	0.9751	1.0497	1.1514	1.0474	0.9640	1.0828	1.0522	1.0170	1.0004	0.9262

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
(**A32**)	SEM			size:2000					
true value	0.95	0.30	0.40	3.00	0.50	5.00	1.00	3.00	**3.50**
mean	0.9511	0.3009	0.4020	3.0002	0.4985	4.9400	0.9977	3.0105	3.4928
bias	-0.0011	-0.0009	-0.0020	-0.0002	0.0015	0.0600	0.0023	-0.0105	0.0072
RMSE	0.0287	0.0139	0.0141	0.1287	0.1567	0.4331	0.0587	0.0665	0.1035
SD ratio	1.1128	1.0081	1.0252	0.9989	0.9870	1.1136	0.9863	0.9057	0.9869
(**A33**)	SEM			size:2000					
true value	0.95	0.30	0.40	3.00	0.50	5.00	1.00	3.00	**4.50**
mean	0.9508	0.3010	0.4017	3.0002	0.4995	4.9408	0.9958	3.0122	4.4948
bias	-0.0008	-0.0010	-0.0017	-0.0002	0.0005	0.0592	0.0042	-0.0122	0.0052
RMSE	0.0291	0.0122	0.0118	0.1274	0.1499	0.3997	0.0673	0.0704	0.1025
SD ratio	1.1068	0.9982	1.0137	0.9943	0.9678	1.0914	0.9773	0.9092	0.9641

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(**A32**)	SEM			size:2000					
mean	0.4999	0.5002	0.4996	0.4992	0.5096	0.4987	0.4989	0.5002	*fixed*
bias	0.0001	-0.0002	0.0004	0.0008	-0.0096	0.0013	0.0011	-0.0002	
RMSE	0.0298	0.0175	0.0206	0.0223	0.1976	0.0229	0.0219	0.0219	
SD ratio	1.0581	0.9334	1.0385	1.0340	1.0452	1.0130	1.0073	0.9442	
(**A33**)	SEM			size:2000					
mean	0.5000	0.5002	0.4996	0.4992	0.5111	0.4987	0.4990	0.5003	*fixed*
bias	0.0000	-0.0002	0.0004	0.0008	-0.0111	0.0013	0.0010	-0.0003	
RMSE	0.0297	0.0175	0.0207	0.0222	0.1733	0.0227	0.0221	0.0214	
SD ratio	1.0538	0.9330	1.0389	1.0329	1.0162	1.0045	1.0156	0.9323	

Table A.55: Simulation Result of the Classical approach (A29 - A33)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A29-A33)	Classical			size:2000						
mean	0.6502	0.6994	0.5980	0.7421	0.7015	0.7977	0.7977	0.8063	0.9021	0.1965
bias	-0.0002	0.0006	0.0020	0.0079	-0.0015	0.0023	0.0023	0.0437	-0.0021	0.0035
RMSE	0.1135	0.1041	0.0280	0.1071	0.0256	0.1230	0.0290	0.2396	0.0469	0.0154
SD ratio	0.9852	1.0370	1.1908	0.9851	1.0982	1.0283	1.1787	0.8944	0.9505	0.8005

Design	Parameters					
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}
true value	0.95	0.30	0.40	3.00	0.50	5.00
(A29-A33)	Classical			size:2000		
mean	0.9506	0.2956	0.3966	2.9936	0.5428	5.2731
bias	-0.0006	0.0044	0.0034	0.0064	-0.0428	-0.2731
RMSE	0.0389	0.0262	0.0406	0.2488	0.3953	1.4196
SD ratio	1.0838	0.9020	0.9226	0.9870	0.9332	0.9936

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A29-A33)	Classical		size:2000						
mean	0.4990	0.4991	0.4988	0.4988	0.7355	0.4976	0.4976	0.5002	*fixed*
bias	0.0010	0.0009	0.0012	0.0012	-0.2355	0.0024	0.0024	-0.0002	
RMSE	0.0348	0.0176	0.0204	0.0232	0.5671	0.0262	0.0222	0.0283	
SD ratio	1.0370	0.9114	1.0060	1.0483	0.5121	0.9875	0.9095	0.9325	

Design	Parameters		
	λ_1	λ_2	λ_3
(A29)	Classical		size:2000
true value	1.00	3.00	**0.50**
mean	1.0109	2.9997	0.5206
bias	-0.0109	0.0003	-0.0206
RMSE	0.2361	0.1959	0.2944
SD ratio	22.4630	54.9387	98.0983
(A30)	Classical		size:2000
true value	1.00	3.00	**1.50**
mean	1.0594	3.0196	1.5390
bias	-0.0594	-0.0196	-0.0390
RMSE	0.2601	0.2103	0.3423
SD ratio	21.0551	51.4765	97.1687
(A31)	Classical		size:2000
true value	1.00	3.00	**2.50**
mean	1.1069	3.0367	2.5558
bias	-0.1069	-0.0367	-0.0558
RMSE	0.3355	0.2323	0.3936
SD ratio	22.7522	48.4532	94.6124
(A32)	Classical		size:2000
true value	1.00	3.00	**3.50**
mean	1.1552	3.0559	3.5741
bias	-0.1552	-0.0559	-0.0741
RMSE	0.4363	0.2569	0.4463
SD ratio	23.3939	43.0559	86.0292
(A33)	Classical		size:2000
true value	1.00	3.00	**4.50**
mean	1.2034	3.0746	4.5919
bias	-0.2034	-0.0746	-0.0919
RMSE	0.5487	0.2850	0.5003
SD ratio	24.1806	39.3455	79.6343

Table A.56: Simulation Result of the SEM approach (A34 - A38)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A34)	SEM			size:2000						
mean	0.6470	0.6980	0.6001	0.7498	0.7006	0.8006	0.7991	0.8502	0.9096	0.1805
bias	0.0030	0.0020	-0.0001	0.0002	-0.0006	-0.0006	0.0009	-0.0002	-0.0096	0.0195
RMSE	0.0404	0.0309	0.0113	0.0313	0.0120	0.0377	0.0125	0.0655	0.0452	0.0794
SD ratio	1.1290	1.0117	1.0026	0.9593	1.0141	1.0864	1.0149	1.0823	1.0612	1.1286
(A35)	SEM			size:2000						
mean	0.6457	0.6979	0.5995	0.7492	0.7002	0.8000	0.7987	0.8464	0.9026	0.1954
bias	0.0043	0.0021	0.0005	0.0008	-0.0002	0.0000	0.0013	0.0036	-0.0026	0.0046
RMSE	0.0377	0.0297	0.0124	0.0304	0.0134	0.0360	0.0133	0.0570	0.0416	0.0474
SD ratio	1.0851	1.0079	0.9908	0.9963	1.0412	1.0774	0.9920	1.0940	1.1203	1.0150
(A36)	SEM			size:2000						
mean	0.6458	0.6979	0.5997	0.7493	0.7003	0.8002	0.7988	0.8465	0.9007	0.1990
bias	0.0042	0.0021	0.0003	0.0007	-0.0003	-0.0002	0.0012	0.0035	-0.0007	0.0010
RMSE	0.0366	0.0291	0.0146	0.0298	0.0156	0.0347	0.0150	0.0486	0.0336	0.0353
SD ratio	1.0843	1.0066	0.9307	0.9697	0.9896	1.0633	0.9315	1.0549	1.0879	0.9179

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
(A34)	SEM			size:2000					
true value	0.95	0.30	0.40	1.00	0.50	1.00	1.00	3.00	**0.50**
mean	0.9566	0.2908	0.4068	1.0024	0.4911	0.9797	0.9963	3.0033	0.5004
bias	-0.0066	0.0092	-0.0067	-0.0024	0.0089	0.0203	0.0037	-0.0033	-0.0004
RMSE	0.0393	0.0694	0.0471	0.0744	0.1115	0.2787	0.0384	0.0532	0.0776
SD ratio	1.0498	1.0879	0.9853	1.1325	1.1001	1.0612	1.0915	1.1057	1.0407
(A35)	SEM			size:2000					
true value	0.95	0.30	0.40	1.00	0.50	1.00	1.00	3.00	**1.50**
mean	0.9535	0.2952	0.4000	1.0057	0.4990	0.9964	0.9983	3.0037	1.5019
bias	-0.0035	0.0048	0.0000	-0.0057	0.0010	0.0036	0.0017	-0.0037	-0.0019
RMSE	0.0396	0.0478	0.0329	0.0691	0.0885	0.2104	0.0736	0.0602	0.0872
SD ratio	1.0601	1.0236	1.0179	1.0848	0.9762	1.0190	1.0640	1.0036	1.0252
(A36)	SEM			size:2000					
true value	0.95	0.30	0.40	1.00	0.50	1.00	1.00	3.00	**2.50**
mean	0.9516	0.2987	0.4003	1.0052	0.4988	0.9945	0.9949	3.0059	2.5049
bias	-0.0016	0.0013	-0.0003	-0.0052	0.0012	0.0055	0.0051	-0.0059	-0.0049
RMSE	0.0319	0.0349	0.0278	0.0661	0.0783	0.1797	0.1053	0.0755	0.1002
SD ratio	1.0153	0.9292	0.9301	1.0645	0.9286	0.9617	0.9564	0.9338	0.9466

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A34)	SEM			size:2000					
mean	0.5004	0.4985	0.5003	0.4957	0.5005	0.4997	0.4988	0.5012	*fixed*
bias	-0.0004	0.0015	-0.0003	0.0043	-0.0005	0.0003	0.0012	-0.0012	
RMSE	0.0250	0.0189	0.0193	0.0226	0.1268	0.0226	0.0199	0.0238	
SD ratio	1.0292	1.0311	1.0032	1.0962	1.0017	1.0635	0.9794	1.1021	
(A35)	SEM			size:2000					
mean	0.5001	0.4984	0.5003	0.4958	0.4964	0.4996	0.4987	0.5025	*fixed*
bias	-0.0001	0.0016	-0.0003	0.0042	0.0036	0.0004	0.0013	-0.0025	
RMSE	0.0247	0.0190	0.0192	0.0225	0.0951	0.0237	0.0198	0.0230	
SD ratio	1.0168	1.0374	0.9998	1.0928	0.9633	1.1179	0.9577	1.0788	
(A36)	SEM			size:2000					
mean	0.5001	0.4984	0.5003	0.4957	0.4990	0.4999	0.4991	0.5027	*fixed*
bias	-0.0001	0.0016	-0.0003	0.0043	0.0010	0.0001	0.0009	-0.0027	
RMSE	0.0250	0.0190	0.0192	0.0226	0.0827	0.0236	0.0196	0.0231	
SD ratio	1.0100	1.0338	0.9995	1.0948	0.9115	1.1414	0.9641	1.0822	

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(**A37**)	SEM			size:2000						
mean	0.6460	0.6980	0.5998	0.7494	0.7003	0.8004	0.7989	0.8470	0.9004	0.2000
bias	0.0040	0.0020	0.0002	0.0006	-0.0003	-0.0004	0.0011	0.0030	-0.0004	0.0000
RMSE	0.0363	0.0290	0.0167	0.0298	0.0176	0.0342	0.0166	0.0464	0.0303	0.0295
SD ratio	1.0879	1.0036	0.8826	0.9721	0.9357	1.0518	0.8794	1.0587	1.0807	0.8737
(**A38**)	SEM			size:2000						
mean	0.6461	0.6980	0.5998	0.7495	0.7003	0.8005	0.7989	0.8472	0.9002	0.2003
bias	0.0039	0.0020	0.0002	0.0005	-0.0003	-0.0005	0.0011	0.0028	-0.0002	-0.0003
RMSE	0.0361	0.0291	0.0184	0.0299	0.0191	0.0340	0.0180	0.0456	0.0287	0.0255
SD ratio	1.0903	0.9976	0.8574	0.9696	0.9032	1.0402	0.8509	1.0681	1.0860	0.8857

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
(**A37**)	SEM			size:2000					
true value	0.95	0.30	0.40	1.00	0.50	1.00	1.00	3.00	**3.50**
mean	0.9513	0.2998	0.4007	1.0046	0.4980	0.9920	0.9922	3.0075	3.5070
bias	-0.0013	0.0002	-0.0007	-0.0046	0.0020	0.0080	0.0078	-0.0075	-0.0070
RMSE	0.0281	0.0285	0.0245	0.0650	0.0756	0.1745	0.1293	0.0895	0.1143
SD ratio	0.9909	0.8773	0.8893	1.0553	0.9206	0.9623	0.9024	0.8900	0.8858
(**A38**)	SEM			size:2000					
true value	0.95	0.30	0.40	1.00	0.50	1.00	1.00	3.00	**4.50**
mean	0.9511	0.3002	0.4008	1.0044	0.4975	0.9904	0.9901	3.0087	4.5087
bias	-0.0011	-0.0002	-0.0008	-0.0044	0.0025	0.0096	0.0099	-0.0086	-0.0087
RMSE	0.0261	0.0243	0.0218	0.0647	0.0745	0.1733	0.1472	0.1010	0.1259
SD ratio	0.9782	0.8500	0.8713	1.0504	0.9191	0.9691	0.8760	0.8695	0.8499

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(**A37**)	SEM			size:2000					
mean	0.5001	0.4984	0.5002	0.4957	0.5007	0.5000	0.4992	0.5027	*fixed*
bias	-0.0001	0.0016	-0.0002	0.0043	-0.0007	0.0000	0.0008	-0.0027	
RMSE	0.0254	0.0190	0.0193	0.0227	0.0803	0.0236	0.0195	0.0231	
SD ratio	1.0001	1.0313	0.9999	1.0981	0.9178	1.1548	0.9684	1.0820	
(**A38**)	SEM			size:2000					
mean	0.5000	0.4984	0.5002	0.4957	0.5016	0.5001	0.4992	0.5027	*fixed*
bias	0.0000	0.0016	-0.0002	0.0043	-0.0016	-0.0001	0.0008	-0.0027	
RMSE	0.0257	0.0189	0.0193	0.0228	0.0792	0.0236	0.0195	0.0230	
SD ratio	0.9906	1.0300	1.0010	1.1013	0.9316	1.1630	0.9714	1.0831	

Table A.57: Simulation Result of the Classical approach (A34 - A38)

Design	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A34-A38)	Classical		size:2000							
mean	0.6571	0.9844	0.6181	0.9792	0.6831	1.0490	0.7737	0.9183	1.1203	-0.2442
bias	-0.0071	-0.2844	-0.0181	-0.2292	0.0169	-0.2490	0.0263	-0.0683	-0.2203	0.4442
RMSE	0.0590	0.9712	0.3940	0.8492	0.2090	0.7314	0.1500	0.1124	0.5983	1.2659
SD ratio	1.0163	0.3484	0.3406	0.4855	0.3826	0.5363	0.4148	0.6725	0.3252	0.6017

Design	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}
true value	0.95	0.30	0.40	1.00	0.50	1.00
(A34-38)	Classical		size:2000			
mean	1.1616	-0.1436	0.4503	1.0097	0.4082	0.6777
bias	-0.2116	0.4436	-0.0503	-0.0097	0.0918	0.3223
RMSE	0.7740	1.7314	0.0771	0.1327	0.1609	0.5003
SD ratio	0.3262	0.5198	0.7680	0.9679	0.6351	0.6477

Design	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A34-A38)	Classical		size:2000						
mean	0.4783	0.4940	0.4988	0.4905	0.6121	0.4935	0.4991	0.4899	*fixed*
bias	0.0217	0.0060	0.0012	0.0095	-0.1121	0.0065	0.0009	0.0101	
RMSE	0.0579	0.0215	0.0231	0.0504	0.1944	0.0434	0.0245	0.0306	
SD ratio	1.0295	1.0057	1.0543	1.4917	0.6038	1.2995	0.9912	1.0746	

Design	λ_1	λ_2	λ_3
(A34)	Classical		size:2000
true value	1.00	3.00	**0.50**
mean	1.0456	3.0037	0.4465
bias	-0.0456	-0.0037	0.0535
RMSE	0.4879	0.2989	0.2044
SD ratio	27.1784	40.0213	39.7036
(A35)	Classical		size:2000
true value	1.00	3.00	**1.50**
mean	1.5890	3.0905	1.2817
bias	-0.5890	-0.0905	0.2183
RMSE	0.9244	0.4077	0.4024
SD ratio	30.8393	40.1363	52.6589
(A36)	Classical		size:2000
true value	1.00	3.00	**2.50**
mean	2.1323	3.1774	2.1168
bias	-1.1323	-0.1774	0.3832
RMSE	1.6302	0.5692	0.6514
SD ratio	33.2068	34.9914	53.6389
(A37)	Classical		size:2000
true value	1.00	3.00	**3.50**
mean	2.6756	3.2642	2.9520
bias	-1.6756	-0.2642	0.5480
RMSE	2.3764	0.7500	0.9104
SD ratio	34.0777	32.1485	52.8495
(A38)	Classical		size:2000
true value	1.00	3.00	**4.50**
mean	3.2190	3.3511	3.7872
bias	-2.2190	-0.3511	0.7128
RMSE	3.1343	0.9391	1.1729
SD ratio	34.3969	30.5297	52.0152

Table A.58: Simulation Result of the SEM approach (A39 - A43)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A39)	SEM			size:2000						
mean	0.6494	0.7018	0.5994	0.7468	0.7014	0.8001	0.7998	0.8462	0.9032	0.1944
bias	0.0006	-0.0018	0.0006	0.0032	-0.0014	-0.0001	0.0002	0.0038	-0.0032	0.0056
RMSE	0.0385	0.0335	0.0099	0.0388	0.0116	0.0386	0.0124	0.0593	0.0280	0.0422
SD ratio	0.8666	0.9498	0.9248	1.0091	1.0356	0.9269	1.0647	1.1247	1.1298	1.0166
(40)	SEM			size:2000						
mean	0.6503	0.7018	0.5997	0.7479	0.7012	0.8007	0.7997	0.8457	0.9013	0.1985
bias	-0.0003	-0.0018	0.0003	0.0021	-0.0012	-0.0007	0.0003	0.0043	-0.0013	0.0015
RMSE	0.0383	0.0313	0.0102	0.0367	0.0117	0.0371	0.0133	0.0510	0.0284	0.0362
SD ratio	0.9218	0.9620	0.8917	1.0334	0.9877	0.9685	1.0874	1.0389	0.9852	0.9773
(A41)	SEM			size:2000						
mean	0.6514	0.7020	0.6000	0.7485	0.7015	0.8014	0.8000	0.8464	0.8997	0.2009
bias	-0.0014	-0.0020	0.0000	0.0015	-0.0015	-0.0014	0.0000	0.0036	0.0003	-0.0009
RMSE	0.0378	0.0299	0.0120	0.0350	0.0133	0.0363	0.0150	0.0456	0.0256	0.0314
SD ratio	0.9485	0.9699	0.8953	1.0463	0.9734	1.0035	1.0803	1.0011	0.9570	0.9954

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}	λ_1	λ_2	λ_3
(A39)	SEM			size:2000					
true value	0.95	0.30	0.40	1.00	0.00	1.00	1.00	3.00	**0.50**
mean	0.9529	0.2965	0.4042	1.0047	0.0049	1.0030	0.9998	3.0038	0.5050
bias	-0.0029	0.0035	-0.0042	-0.0047	-0.0049	-0.0030	0.0002	-0.0038	-0.0050
RMSE	0.0265	0.0428	0.0427	0.0704	0.0919	0.2538	0.0341	0.0490	0.0685
SD ratio	1.0705	0.9880	1.0380	0.8565	0.9867	1.0621	0.9886	0.9187	0.9696
(A40)	SEM			size:2000					
true value	0.95	0.30	0.40	1.00	0.00	1.00	1.00	3.00	**1.50**
mean	0.9511	0.2990	0.4006	1.0027	0.0038	1.0028	0.9992	3.0050	1.5069
bias	-0.0011	0.0010	-0.0006	-0.0027	-0.0038	-0.0028	0.0008	-0.0050	-0.0069
RMSE	0.0291	0.0367	0.0283	0.0665	0.0828	0.2039	0.0569	0.0509	0.0744
SD ratio	0.9885	0.9867	0.9445	0.8198	0.9678	0.9840	0.9306	1.0138	0.9856
(A41)	SEM			size:2000					
true value	0.95	0.30	0.40	1.00	0.00	1.00	1.00	3.00	**2.50**
mean	0.9506	0.3006	0.4013	1.0000	0.0010	0.9955	0.9942	3.0082	2.5110
bias	-0.0006	-0.0006	-0.0013	0.0000	-0.0010	0.0045	0.0058	-0.0082	-0.0110
RMSE	0.0262	0.0305	0.0250	0.0660	0.0787	0.1876	0.0884	0.0655	0.0904
SD ratio	0.9650	0.9907	0.9605	0.8261	0.9514	0.9640	0.9584	1.0571	1.0056

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A39)	SEM			size:2000					
mean	0.4518	0.4903	0.4979	0.4993	0.5594	0.4729	0.4895	0.4887	*fixed*
bias	0.0482	0.0097	0.0021	0.0007	-0.0594	0.0271	0.0105	0.0113	
RMSE	0.1610	0.0217	0.0240	0.0258	0.1573	0.0761	0.0371	0.0293	
SD ratio	0.6516	0.8990	1.1001	1.0900	0.5238	0.3523	1.0131	0.9578	
(A40)	SEM			size:2000					
mean	0.5004	0.4987	0.5023	0.4999	0.4962	0.4990	0.4983	0.4990	*fixed*
bias	-0.0004	0.0013	-0.0023	0.0001	0.0038	0.0010	0.0017	0.0010	
RMSE	0.0227	0.0174	0.0218	0.0222	0.0976	0.0203	0.0217	0.0191	
SD ratio	0.9026	0.9500	1.1192	1.0596	0.9716	1.0154	1.1034	0.8825	
(A41)	SEM			size:2000					
mean	0.5008	0.4987	0.5021	0.4997	0.5004	0.4991	0.4984	0.4989	*fixed*
bias	-0.0008	0.0013	-0.0021	0.0003	-0.0004	0.0009	0.0016	0.0011	
RMSE	0.0230	0.0176	0.0221	0.0221	0.0906	0.0200	0.0216	0.0192	
SD ratio	0.9029	0.9462	1.1181	1.0575	0.9666	1.0100	1.1021	0.8978	

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A42)	SEM			size:2000						
mean	0.6512	0.7018	0.6001	0.7483	0.7016	0.8012	0.8001	0.8460	0.8995	0.2011
bias	-0.0012	-0.0018	-0.0001	0.0017	-0.0016	-0.0012	-0.0001	0.0040	0.0005	-0.0011
RMSE	0.0364	0.0291	0.0140	0.0340	0.0150	0.0355	0.0166	0.0437	0.0237	0.0270
SD ratio	0.9506	0.9976	0.9044	1.0568	0.9701	1.0222	1.0703	0.9936	0.9370	0.9879
(A43)	SEM			size:2000						
mean	0.6509	0.7016	0.6001	0.7482	0.7016	0.8010	0.8001	0.8457	0.8994	0.2011
bias	-0.0009	-0.0016	-0.0001	0.0018	-0.0016	-0.0010	-0.0001	0.0043	0.0006	-0.0011
RMSE	0.0355	0.0287	0.0157	0.0336	0.0165	0.0351	0.0180	0.0426	0.0225	0.0236
SD ratio	0.9542	0.9832	0.9112	1.0669	0.9686	1.0378	1.0624	0.9899	0.9261	0.9842

Design	Parameters								
	b_{71}	b_{73}	b_{83}	ϕ_{22}	φ_{32}	φ_{33}	λ_1	λ_2	λ_3
(A42)	SEM			size:2000					
true value	0.95	0.30	0.40	1.00	0.00	1.00	1.00	3.00	**3.50**
mean	0.9504	0.3008	0.4011	1.0007	0.0017	0.9961	0.9918	3.0101	3.5136
bias	-0.0004	-0.0008	-0.0011	-0.0007	-0.0017	0.0039	0.0082	-0.0101	-0.0136
RMSE	0.0244	0.0260	0.0222	0.0643	0.0764	0.1825	0.1118	0.0808	0.1065
SD ratio	0.9604	0.9874	0.9626	0.8196	0.9422	0.9576	0.9600	1.0592	1.0089
(A43)	SEM			size:2000					
true value	0.95	0.30	0.40	1.00	0.00	1.00	1.00	3.00	**4.50**
mean	0.9503	0.3008	0.4010	1.0014	0.0022	0.9967	0.9902	3.0113	4.5154
bias	-0.0003	-0.0008	-0.0010	-0.0014	-0.0022	0.0033	0.0098	-0.0113	-0.0154
RMSE	0.0233	0.0226	0.0198	0.0630	0.0752	0.1801	0.1293	0.0931	0.1194
SD ratio	0.9554	0.9849	0.9629	0.8172	0.9376	0.9547	0.9609	1.0537	1.0078

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A42)	SEM			size:2000					
mean	0.5006	0.4987	0.5021	0.4997	0.5006	0.4991	0.4984	0.4990	*fixed*
bias	-0.0006	0.0013	-0.0021	0.0003	-0.0006	0.0009	0.0016	0.0010	
RMSE	0.0233	0.0176	0.0221	0.0221	0.0878	0.0199	0.0217	0.0191	
SD ratio	0.9007	0.9468	1.1197	1.0563	0.9661	1.0061	1.1053	0.8975	
(A43)	SEM			size:2000					
mean	0.5005	0.4987	0.5020	0.4998	0.5006	0.4991	0.4984	0.4990	*fixed*
bias	-0.0005	0.0013	-0.0020	0.0002	-0.0006	0.0009	0.0016	0.0010	
RMSE	0.0235	0.0176	0.0221	0.0221	0.0859	0.0198	0.0217	0.0190	
SD ratio	0.8996	0.9473	1.1207	1.0548	0.9667	1.0035	1.1069	0.8950	

Table A.59: Simulation Result of the Classical approach (A39 - A43)

Design	Parameters									
	b_{11}	b_{21}	b_{22}	b_{31}	b_{32}	b_{41}	b_{42}	b_{51}	b_{61}	b_{63}
true value	0.65	0.70	0.60	0.75	0.70	0.80	0.80	0.85	0.90	0.20
(A39-A43)	Classical		size:2000							
mean	0.6721	0.9452	0.3929	0.8837	0.5966	1.0046	0.6335	0.8784	1.1835	-0.1040
bias	-0.0221	-0.2452	0.2071	-0.1337	0.1034	-0.2046	0.1665	-0.0284	-0.2835	0.3040
RMSE	0.0608	0.8631	0.7611	0.3590	0.2941	0.5339	0.4525	0.0794	0.7187	0.7756
SD ratio	0.7499	1.1332	1.1766	0.8809	0.9057	0.9415	0.9741	0.6178	0.4272	0.4277

Design	Parameters					
	b_{71}	b_{73}	b_{83}	ϕ_{22}	ϕ_{32}	ϕ_{33}
true value	0.95	0.30	0.40	1.00	0.00	1.00
(A39-A43)	Classical		size:2000			
mean	1.0897	0.1574	0.4215	0.9981	-0.0631	0.8733
bias	-0.1397	0.1426	-0.0215	0.0019	0.0631	0.1267
RMSE	0.4647	0.4930	0.0552	0.1944	0.1635	0.3815
SD ratio	0.8197	1.1915	0.8335	0.5565	0.7352	0.6303

Design	Parameters								
	$\Theta_\varepsilon(1,1)$	$\Theta_\varepsilon(2,2)$	$\Theta_\varepsilon(3,3)$	$\Theta_\varepsilon(4,4)$	$\Theta_\varepsilon(5,5)$	$\Theta_\varepsilon(6,6)$	$\Theta_\varepsilon(7,7)$	$\Theta_\varepsilon(8,8)$	r_f
true value	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05
(A39-A43)	Classical		size:2000						
mean	0.4518	0.4903	0.4979	0.4993	0.5594	0.4729	0.4895	0.4887	*fixed*
bias	0.0482	0.0097	0.0021	0.0007	-0.0594	0.0271	0.0105	0.0113	
RMSE	0.1610	0.0217	0.0240	0.0258	0.1573	0.0761	0.0371	0.0293	
SD ratio	0.6516	0.8990	1.1001	1.0900	0.5238	0.3523	1.0131	0.9578	

Design	Parameters		
	λ_1	λ_2	λ_3
(A39)	Classical		size:2000
true value	1.00	3.00	**0.50**
mean	2.1748	3.1436	0.3289
bias	-1.1748	-0.1436	0.1711
RMSE	1.3636	0.2912	0.3258
SD ratio	26.6849	21.5673	31.9894
(A40)	Classical		size:2000
true value	1.00	3.00	**1.50**
mean	2.8655	3.2703	1.2551
bias	-1.8655	-0.2703	0.2449
RMSE	2.1135	0.4365	0.4393
SD ratio	25.1512	19.0591	27.5686
(A41)	Classical		size:2000
true value	1.00	3.00	**2.50**
mean	3.5563	3.3970	2.1813
bias	-2.5563	-0.3970	0.3187
RMSE	2.8719	0.5936	0.5569
SD ratio	24.2457	17.9058	25.1987
(A42)	Classical		size:2000
true value	1.00	3.00	**3.50**
mean	4.2470	3.5237	3.1074
bias	-3.2470	-0.5237	0.3926
RMSE	3.6336	0.7552	0.6764
SD ratio	23.6869	17.2852	23.8043
(A43)	Classical		size:2000
true value	1.00	3.00	**4.50**
mean	4.9377	3.6504	4.0336
bias	-3.9377	-0.6504	0.4664
RMSE	4.3969	0.9189	0.7969
SD ratio	23.3181	16.9127	22.9062

Appendix B

Result of the Empirical Study

Table B.1: Estimated factor loading **B** (by the SEM approach)

Stocks	b_{ij}	HSNF	HSNU	HSNP	HSNC	HSI
	estimate	1.1007	–	–	–	-0.1692
x_1	sd	0.2521	–	–	–	0.2267
	t-value	4.3654	–	–	–	-0.7463
	estimate	**1.8120**	–	–	–	-0.8310
x_2	sd	–	–	–	–	0.0486
	t-value	–	–	–	–	-17.0919
	estimate	1.7280	–	–	–	-0.5686
x_3	sd	0.3184	–	–	–	0.2845
	t-value	5.4269	–	–	–	-1.9989
	estimate	–	2.6899	–	–	-0.9452
x_4	sd	–	0.3305	–	–	0.1583
	t-value	–	8.1394	–	–	-5.9695
	estimate	–	1.9671	–	–	-0.5020
x_5	sd	–	0.2480	–	–	0.1220
	t-value	–	7.9323	–	–	-4.1149
	estimate	–	**2.5160**	–	–	-0.8695
x_6	sd	–	–	–	–	0.0417
	t-value	–	–	–	–	-20.8749
	estimate	–	–	3.4307	–	-2.8749
x_7	sd	–	–	0.3735	–	0.4553
	t-value	–	–	9.1861	–	-6.3137
	estimate	1.4947	–	4.0805	–	-5.1460
x_8	sd	0.3892	–	0.5791	–	0.6165
	t-value	3.8399	–	7.0467	–	-8.3472
	estimate	–	–	**5.7410**	–	-5.6215
x_9	sd	–	–		–	0.0654
	t-value	–	–		–	-85.9401
	estimate	3.9281	–	-0.3891	–	-1.8743
x_{10}	sd	0.6829	–	0.6217	–	0.7511
	t-value	5.7517	–	-0.6258	–	-2.4953
	estimate	1.7949	–	0.5145	–	-1.3468
x_{11}	sd	0.4688	–	0.6031	–	0.6597
	t-value	3.8291	–	0.8531	–	-2.0415
	estimate	1.6730	–	0.9346	–	-1.7885
x_{12}	sd	0.4437	–	0.5732	–	0.6208
	t-value	3.7709	–	1.6306	–	-2.8809
	estimate	3.3760	–	–	0.8033	-2.7447
x_{13}	sd	0.5906	–	–	0.7584	0.9907
	t-value	5.7162	–	–	1.0592	-2.7705
	estimate	–	–	–	-3.4155	**5.0650**
x_{14}	sd	–	–	–	0.0531	–
	t-value	–	–	–	-64.2861	–
	estimate	2.0842	–	1.9045	-0.5777	-2.4917
x_{15}	sd	0.5207	–	0.7522	0.9362	1.5703
	t-value	4.0029	–	2.5318	-0.6171	-1.5867
	estimate	–	–	–	0.1822	0.4610
x_{16}	sd	–	–	–	1.0192	1.1663
	t-value	–	–	–	0.1788	0.3953
	estimate	–	–	–	1.7898	-0.9160
x_{17}	sd	–	–	–	0.8654	0.9927
	t-value	–	–	–	2.0681	-0.9228
	estimate	–	–	–	6.1765	-5.5748
x_{18}	sd	–	–	–	1.4637	1.6820
	t-value	–	–	–	4.2199	-3.3143

Stocks	b_{ij}	HSNF	HSNU	HSNP	HSNC	HSI
x_{19}	estimate	–	–	–	1.3368	-0.8430
	sd	–	–	–	0.8574	0.9818
	t-value	–	–	–	1.5591	-0.8587
x_{20}	estimate	–	–	–	3.1241	-2.7156
	sd	–	–	–	1.2226	1.4021
	t-value	–	–	–	2.5554	-1.9368
x_{21}	estimate	-1.8072	–	–	-0.3488	2.5636
	sd	0.5427	–	–	1.1239	1.3410
	t-value	-3.3299	–	–	-0.3103	1.9116
x_{22}	estimate	–	–	–	-3.2862	4.4669
	sd	–	–	–	1.0007	1.1420
	t-value	–	–	–	-3.2839	3.9115
x_{23}	estimate	–	–	–	2.1967	-2.1242
	sd	–	–	–	0.9241	1.0588
	t-value	–	–	–	2.3772	-2.0063
x_{24}	estimate	-3.5702	–	–	0.2651	4.0303
	sd	0.9394	–	–	1.8703	2.2528
	t-value	-3.8003	–	–	0.1418	1.7890
x_{25}	estimate	–	–	–	**5.7060**	-5.2894
	sd	–	–	–		0.0908
	t-value	–	–	–		-58.2524

Table B.2: Estimated risk premium $\boldsymbol{\lambda}$ (by the SEM approach)

λ_j	estimate	s.d.	t-value
HSNF	0.2720	0.1774	1.5334
HSNU	0.2496	0.1033	2.4166
HSNP	0.4316	0.2417	1.7854
HSNC	0.4717	0.2319	2.0340
HSI	0.3922	0.2027	1.9353

Table B.3: Estimated factor covariance matrix $\boldsymbol{\Phi}$ (by the SEM approach)

	ϕ_{ij}	HSNF	HSNU	HSNP	HSNC	HSI
HSNF	estimate	12.1648				
	s.d.	0.1699				
	t-value	71.5877				
HSNU	estimate	6.3889	3.9402			
	s.d.	0.0698	0.1208			
	t-value	91.5494	32.6198			
HSNP	estimate	16.2516	8.5092	22.5923		
	s.d.	0.0487	0.0335	0.0395		
	t-value	333.8247	253.8284	571.4618		
HSNC	estimate	15.3209	8.0658	21.1280	20.2987	
	s.d.	0.0397	0.0303	0.0263	0.0378	
	t-value	385.7214	266.1447	803.5145	537.0934	
HSI	fixed	**13.3915**	**7.0666**	**18.5970**	**17.6632**	**15.4880**

Table B.4: Estimated error covariance matrix Θ_ε (by the SEM approach)

$\Theta_\varepsilon(i,j)$	estimate	s.d.	t-value
$\Theta_\varepsilon(1,1)$	7.9921	0.5961	13.4080
$\Theta_\varepsilon(2,2)$	8.0980	0.6309	12.8354
$\Theta_\varepsilon(3,3)$	10.8765	0.8282	13.1332
$\Theta_\varepsilon(4,4)$	5.8813	0.7026	8.3707
$\Theta_\varepsilon(5,5)$	6.4806	0.5532	11.7144
$\Theta_\varepsilon(6,6)$	4.8656	0.6029	8.0708
$\Theta_\varepsilon(7,7)$	7.2836	0.6379	11.4180
$\Theta_\varepsilon(8,8)$	8.6811	0.7878	11.0194
$\Theta_\varepsilon(9,9)$	4.1682	0.7899	5.2769
$\Theta_\varepsilon(10,10)$	12.5693	1.3314	9.4406
$\Theta_\varepsilon(11,11)$	17.3850	1.2766	13.6185
$\Theta_\varepsilon(12,12)$	15.3024	1.1183	13.6833
$\Theta_\varepsilon(13,13)$	16.8032	1.4960	11.2319
$\Theta_\varepsilon(14,14)$	7.6726	1.0070	7.6195
$\Theta_\varepsilon(15,15)$	13.3226	1.0336	12.8901
$\Theta_\varepsilon(16,16)$	32.8077	2.3106	14.1985
$\Theta_\varepsilon(17,17)$	14.4282	1.1597	12.4411
$\Theta_\varepsilon(18,18)$	20.7610	2.2765	9.1195
$\Theta_\varepsilon(19,19)$	20.3352	1.4725	13.8102
$\Theta_\varepsilon(20,20)$	38.9278	2.8500	13.6588
$\Theta_\varepsilon(21,21)$	30.2673	2.3149	13.0748
$\Theta_\varepsilon(22,22)$	24.0202	1.8365	13.0795
$\Theta_\varepsilon(23,23)$	24.7508	1.7717	13.9700
$\Theta_\varepsilon(24,24)$	67.2028	5.6016	11.9971
$\Theta_\varepsilon(25,25)$	31.2476	2.6562	11.7640
$\Theta_\varepsilon(1,2)$	1.6614	0.4323	3.8437
$\Theta_\varepsilon(2,3)$	1.9158	0.5146	3.7230
$\Theta_\varepsilon(5,8)$	0.3093	0.4348	0.7112
$\Theta_\varepsilon(5,11)$	2.5451	0.5886	4.3241
$\Theta_\varepsilon(6,7)$	0.1697	0.3823	0.4438
$\Theta_\varepsilon(6,14)$	-0.4193	0.4526	-0.9264
$\Theta_\varepsilon(7,14)$	4.3720	0.6183	7.0712
$\Theta_\varepsilon(8,11)$	0.6671	0.7017	0.9506
$\Theta_\varepsilon(10,13)$	7.0106	1.1633	6.0264
$\Theta_\varepsilon(15,17)$	-0.8016	0.7715	-1.0390
$\Theta_\varepsilon(15,19)$	3.1450	0.8766	3.5877
$\Theta_\varepsilon(16,21)$	6.8130	1.6542	4.1186
$\Theta_\varepsilon(17,19)$	-0.9040	0.9248	-0.9776

Table B.5: Estimated squared multiple correlation (by the SEM approach)

x_i	Squared Multiple Correlation
x_1	0.5605
x_2	0.5600
x_3	0.5799
x_4	0.5216
x_5	0.4449
x_6	0.5409
x_7	0.7880
x_8	0.7401
x_9	0.8899
x_{10}	0.6723
x_{11}	0.4234
x_{12}	0.4362
x_{13}	0.6024
x_{14}	0.7499
x_{15}	0.5828
x_{16}	0.1745
x_{17}	0.5822
x_{18}	0.6545
x_{19}	0.2687
x_{20}	0.2450
x_{21}	0.2013
x_{22}	0.2873
x_{23}	0.1079
x_{24}	0.3186
x_{25}	0.4727

Table B.6: Goodness-of-fit statistics (by the SEM approach)

Index	Value
$\chi^2_{d.f.=243}$	410.9891
NNFI	0.9897
GFI	0.9294
AGFI	0.9055
RMSEA	0.0405

Table B.7: Estimated factor loading **B** (by the Classical approach)

Stocks	b_{ij}	HSNF	HSNU	HSNP	HSNC	HSI
x_1	estimate	1.0444	-0.0362	0.3927	-0.5322	0.0221
	sd	0.4442	0.3448	0.5693	0.6073	1.0373
	t-value	2.3513	-0.1051	0.6898	-0.8765	0.0213
x_2	estimate	**1.8120**	–	–	–	-0.8425
	sd	–	–	–	–	0.0493
	t-value	–	–	–	–	-17.0780
x_3	estimate	2.3697	-1.0739	-0.5890	1.1506	-1.2628
	sd	0.6910	0.5396	0.8839	0.9503	1.6129
	t-value	3.4296	-1.9900	-0.6664	1.2108	-0.7829
x_4	estimate	0.7446	2.1441	-1.0031	-0.3932	0.3057
	sd	0.4599	0.3984	0.5951	0.6259	1.0745
	t-value	1.6189	5.3823	-1.6856	-0.6282	0.2845
x_5	estimate	0.6603	1.7512	-0.3352	-0.3074	-0.2362
	sd	0.4220	0.3530	0.5387	0.5735	0.9787
	t-value	1.5648	4.9610	-0.6221	-0.5361	-0.2413
x_6	estimate	–	**2.5160**	–	–	-0.8783
	sd	–	–	–	–	0.0433
	t-value	–	–	–	–	-20.2740
x_7	estimate	0.6588	-0.3213	1.1053	-3.9961	4.1478
	sd	0.4140	0.3204	0.5811	0.7299	1.2588
	t-value	1.5911	-1.0030	1.9021	-5.4749	3.2950
x_8	estimate	2.4278	-1.2544	2.8499	-1.4836	-2.2190
	sd	0.7250	0.5629	0.9873	0.9961	1.7573
	t-value	3.3488	-2.2286	2.8866	-1.4895	-1.2627
x_9	estimate	–	–	**5.7410**	–	-5.6354
	sd	–	–		–	0.0682
	t-value	–	–		–	-82.6601
x_{10}	estimate	8.9271	-4.7084	-5.7316	-5.3881	8.5068
	sd	2.1817	1.6906	2.8078	2.9325	5.0583
	t-value	4.0919	-2.7850	-2.0413	-1.8374	1.6817
x_{11}	estimate	2.1699	0.3038	-0.3993	-2.1720	1.7512
	sd	0.7456	0.5793	0.9538	1.0211	1.7382
	t-value	2.9105	0.5244	-0.4186	-2.1270	1.0075
x_{12}	estimate	1.7443	-0.4369	1.1719	0.4335	-2.4616
	sd	0.6519	0.5059	0.8429	0.8925	1.5320
	t-value	2.6757	-0.8635	1.3904	0.4857	-1.6068
x_{13}	estimate	8.2246	-4.5562	-5.0892	-4.5174	7.3191
	sd	1.9744	1.5474	2.5544	2.6880	4.6202
	t-value	4.1657	-2.9444	-1.9923	-1.6806	1.5842
x_{14}	estimate	–	–	–	-3.3629	**5.0650**
	sd	–	–	–	0.0513	–
	t-value	–	–	–	-65.5991	–
x_{15}	estimate	2.0902	-0.0717	2.2166	0.5651	-4.1765
	sd	0.6721	0.5199	0.8970	0.9272	1.6238
	t-value	3.1102	-0.1378	2.4712	0.6095	-2.5720
x_{16}	estimate	-1.3141	0.4101	0.6917	3.4581	-3.1519
	sd	0.9765	0.7544	1.2429	1.3540	2.2778
	t-value	-1.3457	0.5436	0.5566	2.5539	-1.3837
x_{17}	estimate	0.0045	0.1883	-0.7032	1.5690	0.0904
	sd	0.6968	0.5378	0.8940	0.9765	1.6411
	t-value	0.0065	0.3501	-0.7866	1.6067	0.0551
x_{18}	estimate	1.0309	-0.6438	-0.1974	4.4338	-4.0147
	sd	0.9706	0.7489	1.2315	1.3753	2.2789
	t-value	1.0621	-0.8596	-0.1603	3.2240	-1.7617
x_{19}	estimate	0.5335	0.5489	-0.1115	2.3381	-2.5913
	sd	0.6823	0.5298	0.8960	0.9432	1.5919
	t-value	0.7818	1.0362	-0.1283	2.4788	-1.6278
x_{20}	estimate	-1.5337	1.0082	1.8223	7.0818	-8.5927
	sd	1.2246	0.9435	1.5630	1.7293	2.8944
	t-value	-1.2524	1.0685	1.1659	4.0952	-2.9687

Stocks	b_{ij}	HSNF	HSNU	HSNP	HSNC	HSI
x_{21}	estimate	-2.8556	0.5325	2.1781	3.6573	-3.9632
	sd	1.1447	0.8827	1.4683	1.5833	2.6814
	t-value	-2.4946	0.6033	1.4834	2.3099	-1.4780
x_{22}	estimate	-2.0814	1.4685	2.4024	1.5297	-2.8011
	sd	0.9142	0.7103	1.1839	1.2529	2.1479
	t-value	-2.2768	2.0674	2.0292	1.2209	-1.3041
x_{23}	estimate	0.8918	-0.7113	-1.4866	0.8051	0.7940
	sd	0.7318	0.5681	0.9463	1.0010	1.7131
	t-value	1.2186	-1.2521	-1.5709	0.8043	0.4635
x_{24}	estimate	-3.6240	0.2893	0.8287	3.3338	-0.5555
	sd	1.6459	1.2715	2.1001	2.2820	3.8497
	t-value	-2.2019	0.2275	0.3946	1.4609	-0.1443
x_{25}	estimate	–	–	–	**5.7060**	-5.3308
	sd	–	–	–		0.0925
	t-value	–	–	–		-57.6012

Table B.8: Estimated risk premium $\boldsymbol{\lambda}$ (by the Classical approach)

λ_j	estimate	s.d.	t-value
HSNF	-0.0809	0.0259	-3.1212
HSNU	-0.0682	0.0197	-3.4594
HSNP	-0.0193	0.0315	-0.6125
HSNC	0.0394	0.0313	1.2578
HSI	0.0191	0.0271	0.7025

Table B.9: Estimated factor covariance matrix $\boldsymbol{\Phi}$ (by the Classical approach)

	ϕ_{ij}	HSNF	HSNU	HSNP	HSNC	HSI
HSNF	estimate	12.3264				
	s.d.	0.1805				
	t-value	68.3041				
HSNU	estimate	6.5862	3.9531			
	s.d.	0.1094	0.1164			
	t-value	60.2134	33.9738			
HSNP	estimate	16.3167	8.5340	22.6078		
	s.d.	0.0728	0.0458	0.0485		
	t-value	224.2155	186.3109	466.1709		
HSNC	estimate	15.3845	8.0748	21.1608	20.3309	
	s.d.	0.0597	0.0445	0.0307	0.0393	
	t-value	257.5198	181.3089	689.6517	517.5613	
HSI	fixed	**13.3915**	**7.0666**	**18.5970**	**17.6632**	**15.4880**

Table B.10: Goodness-of-fit statistics (by the Classical approach)

Statistics	Value
Error variance	0.0168
R^2	0.6626

Appendix C

LISREL Program for the Empirical Study (by the SEM Approach)

Finalized SEM program [1]

```
DA    ! Define the total number of variables and the method of analysis.
NI=25 MA=CM

LA    ! Label the observed variables for analysis
x1 x2 x3 x4 x5 x6 x7 x8 x9 x10 x11 x12 x13 x14 x15 x16 x17 x18 x19 x20 x21 x22 x23 x24 x25

RA FI = return.dat    ! Locate the file that contains the raw data.
MO
      NX=25    ! Number of observed variables.
      NK=5     ! Number of unobserved variables.
      TD=SY    ! The error covariance matrix is considered to be symmetric.
      PH=SY    ! The factor covariance matrix is considered to be symmetric.
      TX=FR    ! Free the intercept terms for estimation.
      KA=FR    ! Free the latent means for estimation.

LK    ! Label the unobserved factors in sequence.
HSNF HSNU HSNP HSNC HSNI

PA LX    ! Specify the fixed loading entries by "0" and the free entries by "1".
1 0 0 0 1
0 0 0 0 1
1 0 0 0 1
0 1 0 0 1
0 1 0 0 1
0 0 0 0 1
0 0 1 0 1
1 0 1 0 1
0 0 0 0 1
1 0 1 0 1
1 0 1 0 1
1 0 1 0 1
1 0 0 1 1
```

[1] LISREL regards everything on a line following after an exclamation mark (!) as comments.

```
0 0 0 1 0
1 0 1 1 1
0 0 0 1 1
0 0 0 1 1
0 0 0 1 1
0 0 0 1 1
0 0 0 1 1
1 0 0 1 1
0 0 0 1 1
0 0 0 1 1
1 0 0 1 1
0 0 0 0 1
PA PHI   ! Specify the fixed factor covariance entries by "0" and the free entries by "1".
1
1 1
1 1 1
1 1 1 1
0 0 0 0 0
PA TD   ! Specify the fixed error covariances entries by "0" and the free entries by "1".
1
1 1
0 1 1
0 0 0 1
0 0 0 0 1
0 0 0 0 0 1
0 0 0 0 0 1 1
0 0 0 0 1 0 0 1
0 0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0 0 1
0 0 0 0 1 0 0 1 0 0 1
0 0 0 0 0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0 1 0 0 1
0 0 0 0 0 1 1 0 0 0 0 0 1
0 0 0 0 0 0 0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
PA TX   ! All intercept terms are fixed.
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
PA KA   ! All latent means are free for estimation.
1 1 1 1 1
MA LX
  *
  0      0    0    0    0
1.812    0    0    0    0
```

```
0   0      0      0      0
0   0      0      0      0
0   0      0      0      0
0   2.516  0      0      0
0   0      0      0      0
0   0      0      0      0
0   0      5.741  0      0
0   0      0      0      0
0   0      0      0      0
0   0      0      0      0
0   0      0      0      0
0   0      0      0      5.065
0   0      0      0      0
0   0      0      0      0
0   0      0      0      0
0   0      0      0      0
0   0      0      0      0
0   0      0      0      0
0   0      0      0      0
0   0      0      0      0
0   0      0      0      0
0   0      0      0      0
0   0      0      5.706  0
```

! Values corresponding to fixed entries from "PA LX" will be fixed at the specified values.
! Values corresponding to free entries from "PA LX" will be used as the starting values.

MA TD

```
*
1
1  1
0  1.8682  1
0  0       0 1
0  0       0 0 1
0  0       0 0 0 1
0  0       0 0 0 1 1
0  0       0 0 1 0 0 1
0  0       0 0 0 0 0 0 1
0  0       0 0 0 0 0 0 0 1
0  0       0 0 1 0 0 1 0 0 1
0  0       0 0 0 0 0 0 0 0 0 1
0  0       0 0 0 0 0 0 0 1 0 0 1
0  0       0 0 0 1 1 0 0 0 0 0 0 1
0  0       0 0 0 0 0 0 0 0 0 0 0 0 1
0  0       0 0 0 0 0 0 0 0 0 0 0 0 0  1
0  0       0 0 0 0 0 0 0 0 0 0 0 0 1  0      1
0  0       0 0 0 0 0 0 0 0 0 0 0 0 0  0      0 1
0  0       0 0 0 0 0 0 0 0 0 0 0 0 1  0      1 0 1
0  0       0 0 0 0 0 0 0 0 0 0 0 0 0  0      0 0 0 1
0  0       0 0 0 0 0 0 0 0 0 0 0 0 0  6.6259 0 0 0 0 1
0  0       0 0 0 0 0 0 0 0 0 0 0 0 0  0      0 0 0 0 0 1
0  0       0 0 0 0 0 0 0 0 0 0 0 0 0  0      0 0 0 0 0 0 1
0  0       0 0 0 0 0 0 0 0 0 0 0 0 0  0      0 0 0 0 0 0 0 1
0  0       0 0 0 0 0 0 0 0 0 0 0 0 0  0      0 0 0 0 0 0 0 0 1
```

! Values corresponding to fixed entries from "PA TD" will be fixed at the specified values.
! Values corresponding to free entries from "PA TD" will be used as the starting values.

```
MA PHI
 *
15.4197
 6.2674  9.8654
15.6938  7.8459  27.108
13.1941  6.9666  20.5226  22.5693
13.3915  7.0666  18.5970  17.6632  15.488
! Values corresponding to fixed entries from "PA PHI" will be fixed at the specified values.
! Values corresponding to free entries from "PA PHI" will be used as the starting values.

MA TX
 *
 0.0495 0.0495 0.0495 0.0495 0.0495 0.0495 0.0495 0.0495 0.0495 0.0495 0.0495
 0.0495 0.0495 0.0495 0.0495 0.0495 0.0495 0.0495 0.0495 0.0495 0.0495 0.0495
 0.0495 0.0495 0.0495
! Specify the values corresponding to the fixed intercept terms in "PA TX".

PD
OU SE TV MI ML NS ND=4 IT=1000
! Output standard errors, t-values, M.I. based on the ML algorithm and the provided starting
values.
! Set the maximum number of iterations to 1000 and the number of decimal places to 4.
```

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